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Black, Grey and Watch Lists of alien species in the Czech Republic based on environmental impacts and management strategy

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Abstract

As legislation, research and management of invasive alien species (IAS) are not fully coordinated across countries or different stakeholder groups, one approach leading to more or less standardized activities is based on producing lists of prominent IAS that attain high level of concern and are a subject of priority monitoring and management. These so-called Black, Grey and Watch (alert) Lists represent a convenient starting point for setting priorities in prevention, early warning and management systems. It is important that these lists be based on transparent and robust criteria so as to accommodate interests and perception of impacts by groups of concerned authorities and stakeholders representing sectors as diverse as, e.g. forestry, horticulture, aquaculture, hunting, and nature conservation, and to justify possible trade

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restrictions. The principles for blacklisting need to be general enough to accommodate differences among taxonomic groups (plants, invertebrates, vertebrates) and invaded environments (e.g. aquatic, terrestrial, urban, suburban, seminatural), and must take into account invasion dynamics, the impact the IAS pose, and management strategies suitable for each particular invader.

With these assumptions in mind, we synthesize available information to present Black, Grey and Watch Lists of alien species for the Czech Republic, with recommended categorized management measures for land managers, policy makers and other stakeholders. We took into account differences in the listed species' distribution, invasion status, known or estimated environmental impact, as well as possible management options, and apply these criteria to both plants and animals. Species with lower impact, but for which some level of management and regulation is desirable, are included on the Grey List. Some potentially dangerous species occurring in European countries with comparable climatic conditions, as well as those introduced in the past but without presently known wild populations in the Czech Republic, are listed on the Watch list. In total, there are 78 plant and 39 animal species on the Black List, 47 and 16 on the Grey List, and 25 and 27, respectively, on the Watch List. The multilayered approach to the classification of alien species, combining their impacts, population status and relevant management, can serve as a model for other countries that are in process of developing their Black Lists.

Keywords

Alien species, Black list, Czech Republic, impact, legislative tools, management

Introduction

Impacts of invasive alien species and Black Lists: state of the art

Although only a small proportion of introduced species become naturalized or invasive and have a measurable impact (Lockwood et al. 2013; but see Ricciardi et al. 2013), biological invasions by alien species (introduced to regions outside their native distribution range due to human activities; Richardson et al. 2000, Blackburn et al. 2011) affect the majority of habitats, including semi-natural ones. Invasive alien species (IAS), with their widely documented impacts on biodiversity, ecosystem functioning and economy (Pyšek and Richardson 2010, Vilà et al. 2010, 2011, Pyšek et al. 2012c, Scalera et al. 2012, Follak et al. 2013, Blackburn et al. 2014, Jeschke et al. 2014) are recognized as one of the key components of global environmental change (MEA 2005). Costs due to IAS were estimated to reach up to 5% of global GDP (Pimentel et al. 2001, 2002). In Europe, recent estimates of direct costs due to IAS reach at least 12.7 billion € per year (Kettunen et al. 2009). It is also important to note that direct environmental and eradication costs associated with environmental weeds or pests are only a small fraction of costs caused to agriculture or forestry. Nevertheless, even these figures on overall costs for environmental weeds and pests illustrate the need for an urgent policy response at all scales, from national to international and global, supported by a corresponding scientific knowledge base; the fact that the majority of alien species are introduced intentionally or in association with imported/transported commodities (Hulme et al. 2008, 2009) provides an opportunity for interventions (Roques and Auger-Rozenberg 2006, Dehnen-Schmutz et al. 2007, Kenis et al. 2007).

In Europe, more than 12,000 alien plant and animal species are recorded (DAISIE 2009, www.europe-aliens.org) and the numbers of successfully establishing species continue to grow (Hulme et al. 2009, van Kleunen et al. 2015). Unfortunately, research, legislation, and management of IAS are not fully coordinated, neither within individual countries, nor continentally (Hulme et al. 2009), which leads individual countries to cope with alien species in different ways. The most common approach is based on producing lists of prominent IAS that receive much attention and are prioritized in terms of prevention, monitoring and management. These so-called Black, Grey and Watch (alert) Lists represent a convenient starting point for setting such priorities (European Commission 2014). The necessary condition for making such lists trustworthy is, however, a robust and transparent risk assessment, based on the impacts of individual species, allowing their scientifically defensible selection (Wittenberg and Cock 2001, Verbrugge et al. 2012, Lewis and Porter 2014). The transparency is important so as to accommodate interests and perception of impacts by groups of concerned authorities and stakeholders representing sectors as diverse as, e.g. forestry, horticulture, aquaculture, hunting and nature conservation, and to justify possible trade restrictions (Bayliss et al. 2013, Kelly et al. 2013, Ööpik et al. 2013). Therefore, when developing regional Black Lists, interests that differ among the above-mentioned sectors need to be taken into account. Many intentionally imported alien species are of a high economic value (DiTomaso et al. 2010, Richardson and Rejmánek 2011, Woziwoda et al. 2014), but can have negative impacts on native populations, species and communities due to a wide range of mechanisms and processes that have been described in the literature in the last decade (e.g. Levine et al. 2003, Gaertner et al. 2009, 2011, Mitchell et al. 2010, Pyšek and Richardson 2010, Vilà et al. 2010, 2011, Dodet and Collet 2012, Pyšek et al. 2012c, Scalera et al. 2012, Blackburn et al. 2014, Jeschke et al. 2014). However, although these processes are becoming reasonably well understood, there is still much uncertainty about which particular species will have an impact in specific environmental settings and how the invaded habitats and ecosystems will be impacted (Leung et al. 2012, Blackburn et al. 2014). Ideally, each intentional introduction of a new alien species should be thus preceded by a cost-benefit analysis of negative vs. positive effects on both the environment and socioeconomy (Keller and Drake 2009). The decision should then reflect the climatic and habitat match between the current range of the species and the region to which it is proposed for import, as well as information about previous invasion history and life history traits of the species itself, or its close relatives (Kolar and Lodge 2001, Keller and Springborn 2014).

IAS regulation in Europe and in the Czech Republic

The urgent need to tackle biological invasions, develop a common policy and establish an early warning system in Europe, has been recognized by the European Commission (see the Communication 'Towards an EU Strategy on Invasive Species', (COM (2008) 789 final) and EU Biodiversity Strategy to 2020 (http://ec.europa.eu/environment/nature/biodiversity/comm2006/2020.htm). Part of this activity is aimed at the new EU

Regulation on IAS COM (2013) 620 (European Commission 2014), which is an important legislation on invasive species threatening biodiversity and human well-being (Genovesi et al. 2015). Besides setting a framework for roles and responsibilities among the different bodies dealing with IAS it will include a list of species that pose the most significant threats (list of alien species of the Union concern) and thus should be prohibited from the import, sale, and use in Europe. This list will be prepared by the European Commission on the basis of the criteria set out in the Regulation; the EU member states participate in the process of the preparation of the list (by providing comments and proposals for individual IAS inclusion). Although national Black Lists may play an important role in the process of preparation of the EU list, so far only a few countries have developed their own Black Lists with some legislative support (Essl et al. 2011).

The development of national and regional Black Lists and identification of important species, based on using standard and transparent criteria, is a key aspect of the early warning and information systems. Some European countries or trade sectors (agriculture, aquaculture) already regulate the introduction and transport of selected species, based on risk assessments provided by the European Plant Protection Organisation (EPPO), European Food Safety Authority (EFSA) and UK Department for Environment, Food and Rural Affairs (DEFRA). An example of a working system is international cooperation in the field of agriculture pests (EPPO, DEFRA) which can serve as a template to be followed for the management of IAS in Europe in general (Brunel et al. 2013). Not only legislative tools are affecting the policy on IAS. To prevent the spread of alien species and restrict their trading, a significant component of policy and public involvement are voluntary codes of conduct developed for example for horticulture or sheltered under the Bern Convention (Heywood and Brunel 2011, Caffrey et al. 2014, Halford et al. 2014, Heywood 2014).

In the Czech Republic (78,866 km^2, 10.5 millions of inhabitants), as in many other European countries, there is an elaborate and legislatively well-anchored system of the approach to harmful organisms in agriculture. In the field of nature conservation, legislation is not sufficient and does not adequately respond to the current threats from biological invasions, but the issue of IAS has become in the last years one of the priorities in the Czech national strategic environmental documents (State Environmental Policy 2012–20, State Programme of Nature and Landscape Conservation 2009, Biodiversity Strategy 2005). These documents emphasize the need to focus on IAS, including development of priority lists of species for management, creating financial tools and preparation of new legislation, which will be encouraged by the adoption of the new IAS EU legislation.

Scoring species for Black Lists

Despite significant progress in producing lists of important alien species for individual countries (see review in Essl et al. 2011), a standard methodology for the complex as-

sessment of their impacts only started to appear recently (e.g. Blackburn et al. 2014). Such a framework needs to be accompanied by a close cooperation between policy makers, researchers and practitioners in nature/biodiversity conservation and IAS management, to allow for harmonization of the information flow on IAS (Ricciardi et al. 2000, Kettunen et al. 2009, Shine et al. 2009, Caffrey et al. 2014).

Species with documented strong negative impacts, that threaten ecosystems, habitats or native biota, should be eradicated from the newly invaded sites as fast as possible, and further introductions of such species avoided (Convention on Biological Diversity 1992, Genovesi 2005). However, if resources are limited, the question remains which species, which locations and how (considering feasibility and control methods) should be targeted first, and this prioritization can be addressed by different methods (Humair et al. 2014).

The criteria for placing individual species into particular Black List categories need to be general enough to accommodate differences among various taxonomic groups (plants, invertebrates, vertebrates) and invaded environments (e.g. terrestrial, aquatic; urban, suburban, seminatural), take into account invasion dynamics, the environmental and socio-economic impact they pose and management strategy suitable for each particular invader. The existing Black Lists do not take differences between invaded habitats and management feasibility into account in their assessment, do not cover socio-economic impacts and are restricted to selected taxonomic groups (Essl et al. 2011). Some of the existing impact assessments, serving as a basis for Black Lists, multiply the impact scores by a given species' population status (Gederaas et al. 2012, http://ias.biodiversity.be) but as far as we know, there is no system that incorporates information on the type of invaded habitat and management feasibility into the Black List classification.

Aims of the study

In the Czech Republic, there is a thorough knowledge of biological invasions that has resulted in publications of comprehensive and updated lists of alien plants and animals (Pyšek et al. 2002, 2012b, Šefrová and Laštůvka 2005) with an indication of their invasion status using commonly accepted classification (Richardson et al. 2000, Pyšek et al. 2004, Blackburn et al. 2011). However, the classification of alien species based on management criteria has not been available up to now. Still, for any management planning, setting the priorities among species and habitats is crucial. In this paper we thus combine information on the potential environmental impact of alien species in the Czech Republic, their current or predicted population status, the feasibility of management, and type of invaded habitats. As a synthesis, we present Black, Grey and Watch Lists of alien species for the country, with recommended categorized management measures for land managers, policy makers and other stakeholders.

Data and classification approach

Data sources and species selection

The proposed Black and Grey Lists of alien species in the Czech Republic are based primarily on the existing inventories of plant (Pyšek et al. 2012b) and animal (Šefrová and Laštůvka 2005) alien species. The data from these lists were amended by recent updates of the alien biota in the Czech Republic for particular groups such as fishes (Musil et al. 2010), national museum collections or unpublished records (personal communications and databases). The Watch List of alien species includes those currently not present in the wild in the Czech Republic and occurring there only in captivity or cultivation, but reported from the wild in other European countries with similar climate and habitats. Existing lists of aliens in these comparable countries, as summarized in e.g DAISIE or Nobanis, were thus screened to generate the Watch List for the Czech Republic.

To minimize the possible subjective bias of experts assessing species on original lists, each species was reassessed according to the current state of its population status, invaded habitats, cultivation and farming history, impact on environment (ecology) and socio-economy and with respect to the knowledge of its effective management. The species sharing similar patterns of classification were then grouped into subgroups of Black and Grey Lists (see details below). Species included in Black Lists were those posing significant strong negative effects on the environment and where some management, if available and feasible, should be applied. Grey List was used for species with limited negative environmental impact, where monitoring and local management is also relevant. Species for Watch List were selected from those that may in the near future colonize the territory Czech Republic and whose monitoring and management, due to possible substantial negative environmental impact, is recommended.

The evaluation of alien species occurring in the Czech Republic was done for vascular plants, vertebrates and most invertebrate groups. As the classification of alien plant species in the Czech Republic is more elaborated than that of animals, in terms of their regional population dynamics or abundances (Pyšek et al. 2012a, b), the criteria for the Black List species' assessment were first developed for plants and then adapted for other taxonomic groups.

Criteria for classification

For each species included in the Black, Grey and Watch List based on the above criteria, the following information on their populations was assessed, if available, and used to classify species.

A. Mode of current spread:

1. Plants and animals that are intentionally released into the environment for landscaping, restoration or hunting (the 'release' pathway according to Hulme et al. 2008)

and distribution of the species is highly dependent on human activities. Without presence of humans activities the species will disappear in relatively short time.
2. Current spread is mostly spontaneous without direct contribution of humans. For this category it is not crucial if the initial occurrences resulted from past human activities (abandoned plantations, populations of animals escaped from cultures, contaminants) or results of spontaneous spread from other areas where they are alien. Without presence of human activities the species will remain in the landscape for relatively long time.
3. Combination of release and spontaneous spread.

B. Distribution:
Current distribution regardless of whether the species occurs as a result of release or spontaneous introduction. This categorization does not take into account abundance of the species. Both groups can be represented by dense or sparse populations. Especially in case of regionally widespread species, which are present in numerous, well established and continuously replenished populations, their local management cannot be usually efficient. However, in some cases local management may still be performed to reduce specific impacts, e.g. local and time-restricted trapping of *Neovison vison* (American mink) before the bird breeding season.

1. Regional: Present distribution of the species at a large scale or future expasion not strongly restricted by environmental constraints is expected. Clusters of local populations dispersed across country exchanging individuals due to the transport of propagules or active migration.
2. Local (isolated populations): current and also future distribution in localized area(s) within the Czech Republic. The distribution can be limited by e.g. climate or habitat specificity. The localized distribution makes management efficient if there are effective methods available.

C. Evaluation of environmental impact
Standardized assessment of environmental and socio-economic impact is not available for all alien species in the Czech Republic. Therefore it was assessed using the simplified rationale of GISS (Nentwig et al. 2010, Kumschick et al. 2012, Vaes-Petignat and Nentwig 2014) and the recently suggested unified classification of alien species based on the magnitude of their impacts (Blackburn et al. 2014). The black listing in this study is based primarily on the environmental impact of populations occurring in the outdoor environment, and excludes e.g. alien species only having significant economic impact as storage pests. Due to the lack of direct knowledge on impacts of many species in the Czech Republic, their impact was classified as "potential impact", taking into account any impact of the given species reported from climatically similar regions, and also considering interactions with, or impact of, ecologically similar species. The impact was classified based on expert judgement into three levels ranging from limited (minimal) to moderate and massive, with respect to whether it results in irreversible

negative changes to native populations, species or ecosystems (e.g. due to predation, competition, hybridization, ecosystem functioning). For impact assessment we used data from Kumschick et al. (2015), and Rumlerová et al. (unpublished).

D. Evaluation of socio-economic impact

Socio-economic impact and impact on humans was additionally assessed for taxa with considerable environmental impacts to support final reasoning of recommended management. The weight of socio-economic impact was used and ranked high in case of species like *Ambrosia artemisiifolia* (common ragweed), *Heracleum mantegazzianum* (giant hogweed), where strong negative impact on human health is significant or *Arion vulgaris* (Lusitanian slug), and *Varroa destructor* (varroa mite), which have direct effect on agriculture. The impact was classified based on expert judgement into three levels ranging from minimal to moderate (most weeds and pests) and massive.

E. Management options

Management options were assessed along axes representing the management itself, the context of invaded habitats, and population status. The species were classified according to the applicable management strategy (see details below and in Table 1).

Complete eradication is hardly feasible in the Czech Republic, an inland state surrounded by other countries, and can be only achieved, if at all, by intensive international cooperation followed by continuous sanitary measurements. Although complete eradication is usually feasible only on islands (e.g. Chapuis et al. 2004, Genovesi 2005, Simberloff et al. 2011), in some cases it is an ideal target to which efforts should be directed. In practice, complete eradication is possible only for populations of alien species that do not yet spread. For large infestations consisting of many metapopulations, complete eradication above some threshold is almost impossible due to enormous costs (Rejmánek and Pitcairn 2002, Pluess et al. 2012a, b). High cost of management can be justified only for newly detected occurrences of highly important alien species. Unfortunately, intentions behind eradication attempts are often led by wrong ideas to restore ecosystems to their "historical" state, which is often idealized. Eradication is sometimes initiated by the local public or little-informed conservation activists, and often is accompanied by damages to native communities.

Tolerance (resignation) means to refrain from any systematic attempts to manage the given alien species; although both lead to the same result, reasons for them are fundamentally different: tolerance is result of a decision based on the fact that the given IAS has a low impact, while resignation is an enforced attitude if there are no existing management options. The latter currently happens in e.g. mine disposal sites in northern Bohemia, where management is passive approach, and eradication efforts focused on a few selected plant species and habitats. Many newly introduced plants continuously spread as a result of restoration of brownfields and landscaping (Kabrna et al. 2014). Similarly, for some insects, e.g. *Harmonia axyridis* (harlequin ladybird), any management action is almost impossible.

Table 1. List of selected management options (detailed classification) applied to alien species.

Management option	Description	Recommendation
Tolerance/ resignation	This approach is relevant in many ecosystems/sectors (forestry, fishery) for several reasons. Many alien species occurring now in the landscape are of a high economic importance. This approach is also relevant for large populations of widespread alien species especially in urban and suburban environments. Direct eradication of such species is almost impossible or associated with enormous costs and likely to bring doubtful results.	Tolerance is applicable in several cases. In some urban and suburban areas we recommend to tolerate the species of a high economic value as well as species eradication of which is almost impossible because of their wide distribution. This tolerance should exclude areas of high conservation value where approaches including local eradication with subsequent change of local management can be applied. Tolerance cannot be used in rural landscape where primary aim is to prevent new alien populations from establishing. We recommend to tolerate e.g. large populations formed as a result of old abandoned plantations (e.g. *Robinia pseudoacacia*) or release (crayfish, white-tailed deer).
Eradication	Complete eradication of alien species at national scale. It is usually demanding in terms of financial, time and human labour resources, and would require transboundary coordination in case of species present also in neighbouring countries.	Complete eradication should be used primarily for small and pioneer populations where rapid response is likely to result in successful action. It is also applicable to small populations of relatively large animals where hunting or other effective control is feasible. Eradication is not recommended in urban and suburban environment where it usually fails for several reasons (public opinion, high propagule pressure). The complete eradication of several species currently posing strong negative socio-economic impact can be reasoned.
Containment	Local eradication or suppression of alien species' populations. Depending on infested area and habitat type, the costs can vary. Repeated and continuous management is necessary to meet the goals.	Containment is recommended only for sites with high conservation priorities or to lower the negative impact of selected alien species. Due to high costs and need to repeat the actions regularly it is not recommended in large areas, or urban and suburban environment. Containment can be used to reduce e.g. the propagule pressure.
Removal of populations from abandoned plantations and farming facilities	Removal of populations after cessation of their planting or farming, especially related to biofuel plants and animals bred in cages, fishponds or forest enclosures.	Complete eradication of the populations at local scale is recommended, as there is a high risk of escape into natural environment following the abandonment.
Prevention of spread to (semi-)natural environment	This management option refers mainly to revegetation activities in suburban zones (along road and railway corridors) and to species released for forestry, game hunting or fishery.	This option should be used in most cases to avoid conflicts of nature conservation with forestry, landscaping, agriculture and hunting. If a release of a species into the wild is considered, preference should be given to native or locally native taxa. Examples are e.g. brown vs rainbow trout, or red vs sika deer.
Change of management	Change of management is a widely used method applicable to a wide range of habitats. In rural landscapes such a recommended management (preferred by nature conservation) is similar to the traditional management (regular mowing, removal of shrubs, grazing). This management option includes also hunting and fishery practices.	In case of plants, change of the current management should be used to reduce the cover and therefore impact of local dominants. Important condition is that the management has to be permanent and resulting ecosystem must be of higher natural quality than the previous one. Change of management is relevant for a wide range of stakeholders including forestry, game hunting and fishery.

At present we are unable to stop the invasion of such species, let alone eradicate them completely.

Stratified approach reflects the local/regional context of the invasions and therefore represents, in the vast majority of cases, the optimal strategy. An example is the management of *Robinia pseudoacacia* (black locust) in the Czech Republic, whose planting can be allowed in areas where the stands do not represent an imminent threat to the landscape, but should be prohibited, and extant stands eradicated, from sites with nature conservation needs, such as in and around steppe habitats. Similarly, some economically important alien fish species are tolerated in aquaculture ponds (many of which are localities of high conservation value, and even listed among protected nature reserves and Natura 2000 sites), but in other localities might be subject to management. For example, the native *Salmo trutta* (brown trout) should be preferred over alien salmonid fish, such as *Oncorhynchus mykiss* (rainbow trout), in stream habitats, but alien fish species are less likely to pose a conservation problem in ponds used for recreational fishing. The stratified approach thus discriminates where and when the management of alien species is needed and efficient, and where the eradication is neither effective, nor necessary (e.g. in urban and suburban areas). The stratified management limits counterproductive and useless actions against alien species and places them into the framework of nature protection and traditional land use management.

Results

Although there are differences in life histories, population status and possible management options between plants and animals, in the proposed scheme for black-listing we were able to produce comparable Black, Grey and Watch lists for these groups together. In the Black List, species were assigned into three categories according to their impact, distribution, population dynamics and management strategy (Table 2). It is important to note that individual subgroups of Black Lists do not reflect the importance of the included species in the descending order. Species listed in the Grey List have lower impact than Black-Listed species, but still may require some level of management and regulation. The eradication of Grey-List species at a large scale is not a high priority, nevertheless their management is recommended in some restricted areas with nature protection concerns. Grey and Watch List species should be monitored for any rapid change in their distribution and possible impact, especially on the environment.

In total, there are 78 plant and 39 animal species on the Black List, 47 plant and 16 animal species on the Grey List, and 25 plant and 27 animal species on the Watch List (Appendix).

Table 2. Categories of Black and Grey Lists with indication of recommended management, handling restrictions, species examples and classifying criteria that are derived from environmental and socio-economic impact, population status and distribution of the target species. See Table 1 for details of the categories of recommended management.

Lists category	Grouping criteria	Population status, dynamics and distribution of target species	Recommended local management	Handling and release restrictions	No. of plant species	Plant examples	No. of animal species	Animal examples
BL1	High environmental and socio-economic impact.	Abundant, distributed in a wide range of habitats, throughout the country. Species showing high population growth rate and colonization potential.	Complete eradication; eradications or containment everywhere, disposal of abandoned plantations.	No release; application of trade regulations.	2	*Ambrosia artemisiifolia*, *Heracleum mantegazzianum*	3	*Neovison vison*, *Procyon lotor*, *Varroa destructor*
BL2	Moderate to massive environmental impact. Species depending highly on human actions that promote their spread.	Species often found as remnants of planting in gardens and plantations, or in case of animals introduced for hunting and fishing (released or escaped). Usually species with wide distribution, occurring in urban as well as in (semi-)natural habitats.	Stratified approach; instead of economically important species, alternative native species should be promoted. If necessary for economic activities in areas with low conservation value, keeping in capture could be permitted, with prerequisite of prevention escape, and removal of the captive population once the economic activity has ceased. In case of plants disposal of the remnants of abandoned plantations is needed.	No release, legislative regulations of trade and handling, regulation for planting in suburban and rural landscape, some of the economically important species (marked by *) can be planted outside areas of high natural value.	49	*Acer negundo*, *Ailanthus altissima*, *Robinia pseudoacacia*, *Asclepias syriaca*, *Helianthus tuberosus*, *Solidago* sp. *Symphyotrichum* sp., *Telekia speciosa*, *Pinus strobus*, *Quercus rubra*	*8*	*Cervus nippon*, *Ctenopharyngodon idella*, *Hypophthalmichthys molitrix*, *Oncorhynchus mykiss*, *Ovis musimon*, *Salvelinus fontinalis*
BL3	Moderate to massive environmental impact. Current distribution results from spontaneous spread and unintentional introductions.	Species usually with wide distribution which results mainly from spontaneous spread. Species occur in urban as well as in (semi-)natural habitats.	Stratified approach; due to spontaneous distribution there is no need to tolerate in any area.	No release.	27	*Abutilon theophrasti*, *Bunias orientalis*, *Conyza canadensis*, *Echinochloa crus-galli*, *Iva xanthiifolia*, *Rumex alpinus*, *Senecio inaequidens*	28	*Ameiurus melas*, *Arion vulgaris*, *Cameraria ohridella*, *Dikerogammarus villosus*, *Harmonia axyridis*, *Myocastor coypus*, *Ondatra zibethicus*, *Trachemys scripta*

Lists category	Grouping criteria	Population status, dynamics and distribution of target species	Recommended local management	Handling and release restrictions	No. of plant species	Plant examples	No. of animal species	Animal examples
GL	Currently with limited environmental impact.	Scattered distribution throughout the country, resulting from spontaneous spread and escape from planting or captivity. Can be regionally or locally distributed.	Tolerance; outside areas of a high conservation value no need to take direct actions.	Where appropriate, change in management can be employed to reduce their distribution.	47	*Bidens frondosus*, *Erigeron annuus*, *Impatiens parviflora*, *Juglans regia*, *Lonicera caprifolium*, *Rubrivena polystachya*, *Sedum hispanicum*	16	*Ameiurus nebulosus*, *Astacus leptodactylus*, *Eriocheir sinensis*, *Fascioloides magna*, *Gyrodactylus cyprini*, *Rupicapra rupicapra*

Black and Grey Lists of alien species in the Czech Republic

There are in total 1454 alien vascular plant species recorded in the Czech Republic (36.6% of the total flora; Pyšek et al. 2012a, b), however, the vast majority of them do not have a measurable impact. This group of "low impact species" consist of species that (i) are unable to reproduce or develop viable populations outside cultivation (casuals); (ii) are naturalized but have not expanded their range for a long time, or even failed to persist and became rare (e.g. *Agrostemma githago*, common corn-cockle) and (iii) are locally naturalized, having potentially negative impact (e.g. *Celastrus orbiculatus*, oriental bittersweet), but their sparse distribution still makes management feasible. Within the last group belong species which are candidates for priority monitoring (e.g. biofuel plants like *Paulownia tomentosa*, princess tree). Alien plant species with potentially high risk of environmental and potential negative socio-economic impact thus recruit from naturalized species starting to spread (85 species), or species with continuing spread (61 species).

The assessment of fauna was based on several sources providing an overview of alien animal species occurring in the Czech Republic: 662 species from the DAISIE database (Pergl et al. 2012), 595 species from the catalogue of alien animal species (Šefrová and Laštůvka 2005), and 490 species from the list of alien terrestrial insects occurring in indoor and outdoor environments (Šefrová 2005 and unpublished database of Šefrová et al.). This screening resulted in a total of 680 alien animal species, the majority of which are terrestrial insects (490), followed by other terrestrial and aquatic invertebrates (110) and vertebrates (80). Of the alien terrestrial insects, 249 are known to be restricted to indoor spaces where stable temperature allows them to shelter from harsh winter conditions outside, and the same holds for the majority of arachnids and gastropods. These species, unable to escape into the outdoor environment, were thus not included in the assessment for the Black List. As a result, we identified 184 animal species that occur outdoors and have (or potentially may have) an environmental impact.

There are 102 established (naturalized) but not invasive insect species that have not spread significantly or had already spread in the past and now are considered as a part of resident communities. Among the invasive insects, seven species have an impact on native insects and 41 can be classified also as pests in agriculture, forestry or horticulture. Of these, 28 species cause significant losses to the economy and are therefore permanently monitored and managed; monetary value of the damage to the environment, if at all possible to estimate based on current knowledge, is by an order of magnitude lower than that to economy.

In the list, we retained two invertebrate species known to have more devastating effect on agriculture than on biodiversity, *Arion vulgaris* (Lusitanian slug) and *Varroa destructor* (varroa mite), which potentially can also have a strong environmental impact. *Arion vulgaris* is generally widespread and may influence also natural communities by herbivory and competition with native gastropods; the environmental impacts of *V. destructor* are indirect, through its potential effect on the pollination by honeybees. In aquatic environments, the proportion of invertebrates with possible impact on native

species or ecosystems is relatively high, with representatives from macrozoobenthic molluscs, such as *Dreissena polymorpha* (zebra mussel), or crustaceans, such as the amphipod *Dikerogammarus villosus* (killer shrimp), or invasive crayfish (*Orconectes limosus*, spiny-cheek crayfish; *Pacifastacus leniusculus*, signal crayfish).

Alien vertebrates are the smallest group in terms of species number, but host the highest proportion of species causing ecological impacts. There are marked differences among vertebrate groups. There is no alien bird with negative ecological impact in the Czech Republic, and only one reptile (*Trachemys scripta*, pond slider), which so far does not seem to be able to reproduce in the wild under the local climatic conditions. In contrast, fish and mammals with well documented or potential impact are quite common. Several of these fish (~10 spp.) and mammals (~15 spp.) are already widely distributed in the Czech Republic, and their complete eradication is not feasible. However, local/regional eradication or suppression by management action may be possible. It is therefore important to reduce new introductions and releases and strictly control the vicinity of farming and breeding facilities (e.g. deer parks, fishponds) to prevent or at least diminish escapes into nature.

The groups of alien species classified within the Black (BL1–3) and Grey Lists are characterized mainly by level of impact, type of spread (affecting the management and regulation). Species with high environmental and high socio-economic impact are in BL1. Species with high or medium environmental impact and almost negligible socio-economic impact are then classified according prevailing mode of their spread (BL2, BL3). Species, the environmental impact of which is limited at present, are included in the Grey List (GL). The detailed description of the groups is following:

Species group BL1: Species with the greatest impact and with the strongest regulations recommended/needed; their populations should be managed whenever possible although they are already present in large numbers in the Czech Republic and their complete eradication is not feasible. Whenever feasible, it is important to limit further spread of these species; for species where efficient management strategy is not available at present, research that may provide management options is warranted. The group includes two plant and three animal taxa. Plants listed in these category are rapidly spreading neophytes, an annual *Ambrosia artemisiifolia* (common ragweed) and monocarpic perennial *Heracleum mantegazzianum* (giant hogweed), having strong impacts on native biodiversity and/or posing direct threats to human health (allergy and photodermatitis) (Nielsen et al. 2005, Hejda et al. 2009, Pyšek et al. 2012a). Animal taxa comprise heterogeneous group of species which include *Varroa destructor*, a mite affecting bees, and two mammal species (*Neovison vison*, American mink; *Procyon lotor*, racoon). As *Varroa* has also significant socio-economic impact and is restricted to honey bee colonies, its distribution is monitored and management is already driven by state authorities.

Species group BL2: Species depending highly on human actions that promote their spread (mostly combination of release and spontaneous spread), both types of distribution, and mostly with moderate to massive environmental impact, but minimal socio-economic impact; 49 plant and 8 animal taxa. These species are often found

as remnants of planting in gardens and plantations or in case of animals introduced for hunting and fishing, which facilitates their further spread. Instead of economically important species, alternative native species should be promoted. If necessary for economic activities in areas with low conservation value, keeping in capture could be permitted, with prerequisite of good prevention of escape, and removal of the captive population once the economic activity has ceased. Spontaneous populations outside urban areas or areas of captivity should be reduced by change of local management, or by local eradication campaigns when feasible. Specific focus should be on areas with high conservation value.

Species group BL3: Species whose current distribution results from spontaneous spread and unintentional introductions. They cover species with both types of distribution and impact ranging from limited to massive (Appendix). The recommended strategy for these species is stratified approach balancing between the local needs and the available resources for eradication. As none of the species is planted or released intentionally, the management and trade regulations can be more straightforward than in BL2. If locally necessary and there are known efficient eradication methods for the given species, eradication should be attempted. In urban and suburban environments species can be tolerated, but eradication or suppression by change of local management (land use) is recommended.

Species group GL: Species with limited environmental impact at present, distributed both regionally and locally, and with current distribution as a results of spontaneous or combined spread. For the listed species outside areas of a high conservation value there is no need to take actions against them, or restrict them. Change in management may be actively taken into account to reduce their distribution. This group consists of 47 plants and 16 animals, and is substantially formed of several weedy plant species and parasites.

Watch List of alien plant and animal species

The Watch List (Appendix) contains selected high-impact species that (1) have not yet been recorded from the Czech Republic but occur in other European countries with similar climatic conditions and habitats (and thus may be successfully introduced to or invade the Czech territory), (2) species that are at present kept in culture or enclosures only (such as *Capra aegagrus*, wild goat, or *Bison bison*, American bison), or (3) species introduced in the past but without presently known wild populations, which may be considered potential competitors for native species (several fish species). In case of plants this is analogous to species already present in e.g. gardens, parks or aquaculture (e.g. *Azolla filiculoides*, Pacific mosquitofern; *Paulownia tomentosa*, princess tree) which may in the future establish in the wild and became problematic. There are 25 plant and 27 animal taxa on the Watch List. For these species, as well as for some sparsely distributed species from the Black or Grey Lists, preventive actions against their introduction to and subsequent spread in the country, or uninvaded regions, are justified.

Discussion

This paper provides the first assessment of alien species in the Czech Republic in terms of their environmental impact, with direct habitat-related recommendations for land managers, policy makers and other stakeholders. Introduction and naturalization of a new species is a dynamic process (Blackburn et al. 2011, Richardson and Pyšek 2012, Lockwood et al. 2013), therefore the published lists of this kind are not and cannot be definitive. One of the important aspects of such a work is that it can stimulate discussion on the assessment of individual species as well suggestions of possible additions or deletions, from people involved in research, management, as well as general public.

It has to be highlighted that the proposed groups BL2 and BL3 within the Black List do not show the importance of the included species for prioritization of the management as their environmental impacts, though not negligible, may vary. The grouping is used mainly to differentiate between various management options in respect to particular site conditions. Furthermore, these lists are based on environmental rather than socio-economic impact. Thus, we did not include in the list pests causing heavy economic losses, like *Leptinotarsa decemlineata* (Colorado potato beetle), the impact of which is restricted exclusively to agriculture. In contrast, we included, for example, *Varroa destructor*, whose impact on commercial honey bees may have indirect environmental consequences through effects on pollination of many plant species.

Within the Grey List, we included also a taxon that, despite being a part of the alien fauna in the Czech Republic, does not require management in the wild but rather import restrictions. This is the case of the Chinese mitten crab (*Eriocheir sinensis*), a potential host of a serious pathogen that can be transmitted to freshwater crayfish, i.e., native species of conservation relevance (Svoboda et al. 2014). Due to its transient occurrence in the Czech Republic (during periodic migrations only), this species was not listed in group BL3 that includes alien crayfish species with the same capability but established in the country and thus eligible for local management. For the Chinese mitten crab, a legislative ban of release into the wild as well as regulation of trade and import of live individuals are recommended; if an import is considered, only dead animals for food market should be imported.

The system presented here follows the recommendations of IUCN that all newly introduced alien species should be treated as "guilty until proven innocent", following the precautionary principle (Genovesi 2005). The proper evaluation of a species is hindered by a possible lag phase between the introduction and naturalization (Williamson et al. 2005, Blackburn et al. 2011) and a wide range of possible impacts that are context-dependent (Pyšek et al. 2012c, Hulme et al. 2013, Horáčková et al. 2014). In reality, the recognition of problematic invasive alien species in early stages is very difficult and usually not possible until the species is widely distributed; at that stage, however, it is usually too late for its easy eradication (Pluess et al. 2012b).

Invasive alien species are responsible for many negative effects on native species and ecosystems, particularly in areas with a high conservation status (Foxcroft et al. 2013) where IAS management is costly and makes up a large proportion of the pro-

tected area management budget (Frazee et al. 2003). In contrast, in many ecosystems, human activities and resulting land-use change, such as increasing intensification of agriculture and urbanization, or abandonment of industrial areas, promotes existence of "novel" habitats where some alien species might be a valuable component (Hobbs et al. 2006, Gaertner et al. 2012). This is the case of green areas in and around cities where the native species diversity is reduced and vegetation is composed of a few dominant native species accompanied by aliens with a relative low cover. Urban areas are a significant source of alien species (Aronson et al. 2014, Kowarik et al. 2013), but they also fill important ecosystem services with wide socio-economic implications. Therefore, to eradicate or not is often not a simple decision, especially if one takes into account financial costs and feasibility of such a management action.

A separate issue related to alien species and our proposed Black, Grey and Watch Lists are recent developments in the area of biofuel plants and animal species imported for aquaculture and farming. It has been suggested that the traits of an ideal biofuel species are the same as those favouring invasiveness (Raghu et al. 2006, Buddenhagen et al. 2009, Smith et al. 2015). Some of the biofuel species (*Arundo donax*, giant cane; *Psidium cattleianum*, cattley guava) are even listed among 100 of the worst global invaders of the IUCN (Lowe et al. 2000). In the Czech Republic, the issue of importing and planting potentially invasive species is manifested by the biofuel or forestry species such as *Reynoutria* taxa, or *Quercus rubra* and *Paulownia tomentosa*, respectively. For such cases, we advocate a stratified approach based on the type of the invaded habitat, and habitat-related nature conservation needs. A knowledge-based and region-specific differentiated approach is much more suitable than efforts aimed at complete eradication, regardless of circumstances, which is in most cases hardly possible anyway (Rejmánek and Pitcairn 2002, Pluess et al. 2012a, b).

Our aim was to make the Lists on the one hand relatively comprehensive but on the other hand simple enough for later implementation into policy tools. Such an approach was reflected in the composition of the Watch List. It contains species that are not present in the Czech Republic but require attention (because they are already established and cause impact in the neighbouring countries or areas in Europe with similar climatic conditions, and their import is highly probable), but also species already present in the Czech Republic, but currently still restricted to cultivation, captivity or another kind of controlled environment. This allows for raising attention to those "knocking on the door" as well as those already cultivated/farmed species which should be monitored.

Implementing the Black Lists into legislative tools in the Czech Republic is, as in many other countries, constrained by limited integration of IAS-related agendas among different sectors and individual concerned bodies (e.g. nature protection, agriculture, forestry, aquaculture and fishery, hunting, pet industry and trade with various species and products, research, municipalities etc.). In the Czech Republic, the issue of IAS falls within the competence of the Ministry of Environment, but some activities which can on the one hand promote IAS (e.g. biofuel plants, horticulture), or on the other hand control them (e.g. phytosanitary and veterinary measures) are under

the competence of other sectors, primarily the Ministry of Agriculture. Unfortunately, due to the different interests of each sector, cooperation between them is not very effective at present. These different interests lead to the inconsistency and weakening of the legislative instruments, unclear competences in the field of IAS, as well as to their ineffective management. Therefore, an essential condition of any progress in the Czech Republic is to communicate the goals and problems caused by IAS to the general public, stakeholders and policy makers to be able to successfully incorporate the legislative measures, and preventive and control management. Implementation of the new EU Regulation will significantly facilitate this process.

The lists presented here are the first attempt to provide basis for setting the priorities of policy and nature protection at the national level in the Czech Republic. The lists should also serve as a national starting point for discussion on priority IAS species at the EU level, based on the new EU Regulation on IAS (Caffrey et al. 2014, European Commission 2014). As the EU List has to take into account interests of individual member states, it will likely reflect to a large extent political interests rather than purely scientific assessment. Therefore national lists may provide a more flexible and effective way of dealing with invasive species. Compared to other existing Black and Grey Lists for other European countries (Essl et al. 2011, Gederaas et al. 2012, Nehring et al. 2013), our approach also takes into account invaded habitats and feasibility and meaningfulness of potential management; we believe that such a methodological approach to prioritization of species represents important advancement, transferable to other regions in Europe and elsewhere.

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References

Aronson MFJ, La Sorte FA, Nilon CH, Katti M, Goddard MA, Lepczyk CA, Warren PS, Williams NSG, Cilliers S, Clarkson B, Dobbs C, Dolan R, Hedblom M, Klotz S, Louwe

Koojimans J, Kühn I, MacGregor-Fors I, McDonnell M, Mörtberg U, Pyšek P, Siebert S, Sushinsky J, Werner P, Winter M (2014) A global analysis of the impacts of urbanization on bird and plant diversity reveals key anthropogenic drivers. Proceedings of the Royal Society B 281: 20133330. doi: 10.1098/rspb.2013.3330

Bayliss H, Stewart G, Wilcox A, Randall N (2013) A perceived gap between invasive species research and stakeholder priorities. NeoBiota 19: 67–82. doi: 10.3897/neobiota.19.4897

Blackburn TM, Essl F, Evans T, Hulme PE, Jeschke JM, Kühn I, Kumschick S, Marková Z, Mrugała A, Nentwig W, Pergl J, Pyšek P, Rabitsch W, Ricciardi A, Richardson DM, Sendek A, Vilà M, Wilson JRU, Winter M, Genovesi P, Bacher S (2014) A unified classification of alien species based on the magnitude of their environmental impacts. PLoS Biology 12: e1001850. doi: 10.1371/journal.pbio.1001850

Blackburn TM, Pyšek P, Bacher S, Carlton JT, Duncan RP, Jarošík V, Wilson JRU, Richardson DM (2011) A proposed unified framework for biological invasions. Trends in Ecology & Evolution 26: 333–339. doi: 10.1016/j.tree.2011.03.023

Brunel S, Suffert M, Petter F, Baker R (2013) Interface between pest risk science and policy: the EPPO perspective. NeoBiota 18: 9–23. doi: 10.3897/neobiota.18.4049

Buddenhagen CE, Chimera C, Clifford P (2009) Assessing biofuel crop invasiveness: a case study. PLoS ONE 4: e5261. doi: 10.1371/journal.pone.0005261

Caffrey JM, Joe M, Baars J-R, Barbour JH, Boets P, Boon P, Davenport K, Dick JTA, Early J, Edsman L, Gallagher C, Gross J, Heinimaa P, Horrill C, Hudin S, Hulme PE, Hynes S, MacIsaac HJ, McLoone P, Millane M, Moen TL, Moore N, Newman J, O'Conchuir R, O'Farrell M, O'Flynn C, Oidtmann B, Renals T, Ricciardi A, Roy H, Shaw R, Weyl O, Williams F, Lucy FE (2014) Tackling invasive alien species in Europe: the Top 20 issues. Management of Biological Invasions 5: 1–20. doi: 10.3391/mbi.2014.5.1.01

Chapuis JL, Frenot Y, Lebouvier M (2004) Recovery of native plant communities after eradication of rabbits from the subantarctic Kerguelen Islands, and influence of climate change. Biological Conservation 117: 167–179. doi: 10.1016/S0006-3207(03)00290-8

Convention on Biological Diversity (1992) http://www.cbd.int

DAISIE (2009) Handbook of alien species in Europe. Springer, Berlin, 1–399.

Dehnen-Schmutz K, Touza J, Perrings C, Williamson M (2007) The horticultural trade and ornamental plant invasions in Britain. Conservation Biology 21: 224–231. doi: 10.1111/j.1523-1739.2006.00538.x

DiTomaso JM, Reaser JK, Dionigi CP, Doering OC, Chilton E, Schardt JD, Barney JN (2010) Biofuel versus bioinvasion: seeding policy priorities. Environmental Science & Technology 44: 6906–6910. doi: 10.1021/es100640y

Dodet M, Collet C (2012) When should exotic forest plantation tree species be considered as an invasive threat and how should we treat them? Biological Invasions 14: 1765–1778. doi: 10.1007/s10530-012-0202-4

Essl F, Nehring S, Klingenstein F, Milasowszky N, Nowack C, Rabitsch W (2011) Review of risk assessment systems of IAS in Europe and introducing the German-Austrian black list information system (GABLIS). Journal for Nature Conservation 19: 339–350. doi: 10.1016/j.jnc.2011.08.005

European Commission (2014) Regulation (EU) No 1143/2014 of the European Parliament and of the Council of 22 October 2014 on the Prevention and Management of the Introduction and Spread of Invasive Alien Species. Brussels.

Follak S, Dullinger S, Kleinbauer I, Moser D, Essl F (2013) Invasion dynamics of three allergenic invasive Asteraceae (*Ambrosia trifida*, *Artemisia annua*, *Iva xanthiifolia*) in central and eastern Europe. Preslia 85: 41–61.

Foxcroft LC, Pyšek P, Richardson DM, Genovesi P (Eds) (2013) Plant Invasions in Protected Areas – Patterns, Problems and Challenges. Springer, Dordrecht, 656 pp. doi: 10.1007/978-94-007-7750-7

Frazee SR, Cowling RM, Pressey RL, Turpie JK, Lindenberg N (2003) Estimating the costs of conserving a biodiversity hotspot: a case-study of the Cape Floristic Region, South Africa. Biological Conservation 112: 275–290. doi: 10.1016/S0006-3207(02)00400-7

Gaertner M, Breeyen AD, Hui C, Richardson DM (2009) Impacts of alien plant invasions on species richness in Mediterranean-type ecosystems: a meta-analysis. Progress in Physical Geography 33: 319–338. doi: 10.1177/0309133309341607

Gaertner M, Fisher J, Sharma G, Esler K (2012) Insights into invasion and restoration ecology: time to collaborate towards a holistic approach to tackle biological invasions. NeoBiota 12: 57–76. doi: 10.3897/neobiota.12.2123

Gaertner M, Richardson DM, Privett SDJ (2011) Effects of alien plants on ecosystem structure and functioning and implications for restoration: insights from three degraded sites in South African Fynbos. Environmental Management 48: 57–69. doi: 10.1007/s00267-011-9675-7

Gederaas L, Moen TL, Skjelseth S, Larsen L-K (Eds) (2012) Alien species in Norway – with the Norwegian Black List. The Norwegian Biodiversity Information Centre, Norway.

Genovesi P (2005) Eradications of invasive alien species in Europe: a review. Biological Invasions 7: 127–133. doi: 10.1007/1-4020-3870-4_12

Genovesi P, Carboneras C, Vilà M, Walton P (2015) EU adopts innovative legislation on invasive species: a step towards a global response to biological invasions? Biological Invasions 17: 1307–1311. doi: 10.1007/s10530-014-0817-8

Halford M, Heemers L, Dierickx M, Van Wesemael D, Mathys C, Mahy G (2014) Regulation and self-regulation instruments to prevent deliberate introductions of Invasive Alien Plants. A review with a focus on voluntary approaches. Discussion aper. AlterIAS Project http://www.alterias.be/images/stories/downloads/Article/discussion_paper_regulation_selfregulation_iap.pdf [accessed August 2014]

Hejda M, Pyšek P, Pergl J, Sádlo J, Chytrý M, Jarošík V (2009) Invasion success of alien plants: do habitats affinities in the native distribution range matter? Global Ecology and Biogeography 18: 372–382. doi: 10.1111/j.1466-8238.2009.00445.x

Heywood VH (2014) Voluntary codes of conduct for botanic gardens and horticulture and engagement with the public. EPPO Bulletin 44: 223–231. doi: 10.1111/epp.12112

Heywood VH, Brunel S (2011) Code of conduct on horticulture and Invasive Alien Plants. Nature and Environment no. 162. Council of Europe Publishing (Strasbourg).

Hobbs RJ, Arico S, Aronson J, Baron JS, Bridgewater P, Cramer VA, Epstein PR, Ewel JJ, Klink CA, Lugo AE, Norton D, Ojima D, Richardson DM, Sanderson EW, Valladares F, Vilà M, Zamora R, Zobel M (2006) Novel ecosystems: theoretical and management

aspects of the new ecological world order. Global Ecology and Biogeography 15: 1–7. doi: 10.1111/j.1466-822X.2006.00212.x

Horáčková J, Juřičková L, Jarošík V, Šizling A, Pyšek P (2014) Invasiveness does not predict impact: response of native land snail communities to plant invasions in riparian habitats. PLoS ONE 9: e108296. doi: 10.1371/journal.pone.0108296

Hulme PE, Bacher S, Kenis M, Klotz S, Kühn I, Minchin D, Nentwig W, Olenin S, Panov V, Pergl J, Pyšek P, Roques A, Sol D, Solarz W, Vilà M (2008) Grasping at the routes of biological invasions: a framework for integrating pathways into policy. Journal of Applied Ecology 45: 403–414. doi: 10.1111/j.1365-2664.2007.01442.x

Hulme PE, Pyšek P, Jarošík V, Pergl J, Schaffner U, Vilà M (2013) Bias and error in current knowledge of plant invasions impacts. Trends in Ecology & Evolution 28: 212–218. doi: 10.1016/j.tree.2012.10.010

Hulme PE, Pyšek P, Nentwig W, Vilà M (2009) Will threat of biological invasions unite the European Union? Science 324: 40–41. doi: 10.1126/science.1171111

Humair F, Edwards PJ, Siegrist M, Kueffer C (2014) Understanding misunderstandings in invasion science: why experts don't agree on common concepts and risk assessments. NeoBiota 20: 1–30. doi: 10.3897/neobiota.20.6043

Jeschke JM, Bacher B, Blackburn TM, Dick JTA, Essl F, Evans T, Gaertner M, Hulme PE, Kühn I, Mrugala A, Pergl J, Pyšek P, Rabitsch W, Ricciardi A, Richardson DM, Sendek A, Vilà M, Winter M, Kumschick S (2014) Defining the impact of non-native species. Conservation Biology 28: 1188–1194. doi: 10.1111/cobi.12299

Kabrna M, Hendrychová M, Prach K (2014) Establishment of target and invasive plant species on a reclaimed coal mining dump in relation to their occurrence in the surroundings. International Journal of Mining, Reclamation and Environment 28: 242–249. doi: 10.1080/17480930.2013.820390

Keller RP, Drake JM (2009) Trait-based risk assessment for invasive species. In: Keller RP, Lodge DM, Lewis MA, Shogren JF (Eds) Bioeconomics of invasive species. Oxford University Press, New York, 44–62.

Keller RP, Springborn MR (2014) Closing the screen door to new invasions. Conservation Letters 7: 285–292. doi: 10.1111/conl.12071

Kelly J, O'Flynn C, Maguire C (2013) Risk analysis and prioritisation for invasive and non-native species in Ireland and Northern Ireland. Report prepared for the Northern Ireland Environment Agency and National Parks and Wildlife Service as part of Invasive Species Ireland.

Kenis M, Rabitsch W, Auger-Rozenberg M-A, Roques A (2007) How can alien species inventories and interception data help us prevent insect invasions? Bulletin of Entomological Research 97: 489–502. doi: 10.1017/S0007485307005184

Kettunen M, Genovesi P, Gollasch S, Pagad S, Starfinger U, ten Brink P, Shine C (2009) Technical support to EU Strategy on Invasive Alien Species (IAS) – Assessment of the impacts of IAS in Europe and the EU. Institute for European Environmental Policy, London and Brussels.

Kolar CS, Lodge DM (2001) Progress in invasion biology: predicting invaders. Trends in Ecology & Evolution 16: 199–204. doi: 10.1016/S0169-5347(01)02101-2

Kowarik I, von der Lippe M, Cierjacks A (2013) Prevalence of alien versus native species of woody plants in Berlin differs between habitats and at different scales. Preslia 85: 113–132.

Kumschick S, Bacher S, Dawson W, Heikkilä J, Sendek A, Pluess T, Robinson T, Kühn I (2012) A conceptual framework for prioritization of invasive alien species for management according to their impact. NeoBiota 15: 69–100. doi: 10.3897/neobiota.15.3323

Kumschick S, Bacher S, Evans T, Marková Z, Pergl J, Pyšek P, Vaes-Petignat S, van der Veer G, Vilà M, Nentwig W (2015) Comparing impacts of alien plants and animals using a standard scoring system. Journal of Applied Ecology 52: 552–561. doi: 10.1111/1365-2664.12427

Leung B, Roura-Pascual N, Bacher S, Heikkilä J, Brotons L, Burgman MA, Dehnen-Schmutz K, Essl F, Hulme PE, Richardson DM, Sol D, Vilà M, Rejmánek M (2012) TEASIng apart alien species risk assessments: a framework for best practices. Ecology Letters 15: 1475–1493. doi: 10.1111/ele.12003

Levine JM, Vilà M, D'Antonio CM, Dukes JS, Grigulis K, Lavorel S (2003) Mechanisms underlying the impacts of exotic plant invasions. Proceedings of the Royal Society of London Series B-Biological Sciences 270: 775–781. doi: 10.1098/rspb.2003.2327

Lewis KC, Porter RD (2014) Global approaches to addressing biofuel-related invasive species risks and incorporation into U.S. laws and policies. Ecological Monographs 84: 171–201. doi: 10.1890/13-1625.1

Lockwood JL, Hoopes MF, Marchetti MP (2013) Invasion ecology. Second Edition. Wiley, Chichester, 466 pp.

Lowe S, Browne M, Boudjelas S, De Poorter M (2000) 100 of the world's worst invasive alien species: a selection from the global invasive species database. The IUCN Invasive Species Specialist Group (ISSG), Auckland, New Zealand, 1–12.

Millennium Ecosystem Assessment (2005) Ecosystems and human well-being: synthesis. Island Press, Washington, DC, 160 pp.

Mitchell CE, Blumenthal D, Jarošík V, Pulley EE, Pyšek P (2010) Controls on pathogen species richness in plants' introduced and native ranges: roles of residence time, range size, and host traits. Ecology Letters 13: 1525–1535. doi: 10.1111/j.1461-0248.2010.01543.x

Musil J, Jurajda P, Adámek Z, Horký P, Slavík O (2010) Non-native fish introductions in the Czech Republic – species inventory, facts and future perspectives. Journal of Applied Ichthyology 26: 38–45. doi: 10.1111/j.1439-0426.2010.01500.x

Nehring S, Essl F, Rabitsch W (2013) Methodik der naturschutzfachlichen Invasivitätsbewertung für gebietsfremde Arten. Version 1.2 BfN-Skripten 340: 1–46.

Nentwig W, Kühnel E, Bacher S (2010) A generic impact-scoring system applied to alien mammals in Europe. Conservation Biology 24: 302–311. doi: 10.1111/j.1523-1739.2009.01289.x

Nielsen C, Ravn HP, Nentwig W, Wade M (Eds) (2005) The giant hogweed best practice manual. Guidelines for the management and control of an invasive alien weed in Europe. Forest and Landscape Denmark, Hoersholm, 44 pp.

Ööpik M, Bunce RGH, Tischler M (2013) Horticultural markets promote alien species invasions: an Estonian case study of herbaceous perennials. NeoBiota 17: 19–37. doi: 10.3897/neobiota.17.4217

Pergl J, Nentwig W, Winter M, Bacher S, Essl F, Genovesi P, Hulme PE, Jarošík V, Kühn I, Pyšek P, Roques A, Roy D, Vilà M, Roy H (2012) Progress on DAISIE: ALIEN species inventories in Europe updated. In: Neobiota 2012, 7th European Conference on Biological Invasions, Pontevedra, Spain, 12–14 Sept 2012.

Pimentel D, McNair S, Janecka J, Wightman J, Simmonds C, O'Connell C, Wong E, Russel L, Zern J, Aquino T, Tsomondo T (2001) Economic and environmental threats of alien plant, animal, and microbe invasions. Agroecosystems and Environment 84: 1–20. doi: 10.1016/S0167-8809(00)00178-X

Pimentel D, McNair S, Janecka J, Wightman J, Simmonds C, O'Connel C, Wong E, Russel L, Zern J, Aquino T, Tsomondo T (2002) Economic and environmental threats of alien plant, animal, and microbe invasions. In: Pimentel D (Ed.) Biological invasions: economic and environmental costs of alien plant, animal, and microbe species. CRC Press, Boca Raton, FL, 307–329.

Pluess T, Cannon R, Jarošík V, Pergl J, Pyšek P, Bacher S (2012a) When are eradication campaigns successful? A test of common assumptions. Biological Invasions 14: 1365–1378. doi: 10.1007/s10530-011-0160-2

Pluess T, Jarošík V, Pyšek P, Cannon R, Pergl J, Breukers A, Bacher S (2012b) Which factors affect the success or failure of eradication campaigns against alien species? PLoS One 7: e48157. doi: 10.1371/journal.pone.0048157

Pyšek P, Chytrý M, Pergl J, Sádlo J, Wild J (2012a) Plant invasions in the Czech Republic: current state, introduction dynamics, invasive species and invaded habitats. Preslia 84: 575–630.

Pyšek P, Danihelka J, Sádlo J, Chrtek J Jr, Chytrý M, Jarošík V, Kaplan Z, Krahulec F, Moravcová L, Pergl J, Štajerová K, Tichý L (2012b) Catalogue of alien plants of the Czech Republic (2nd edition): checklist update, taxonomic diversity and invasion patterns. Preslia 84: 155–255.

Pyšek P, Jarošík V, Hulme PE, Pergl J, Hejda M, Schaffner U, Vilà M (2012c) A global assessment of invasive plant impacts on resident species, communities and ecosystems: the interaction of impact measures, invading species' traits and environment. Global Change Biology 18: 1725–1737. doi: 10.1111/j.1365-2486.2011.02636.x

Pyšek P, Richardson DM (2010) Invasive species, environmental change and management, and health. Annual Review of Environment and Resources 35: 25–55. doi: 10.1146/annurev-environ-033009-095548

Pyšek P, Richardson DM, Rejmánek M, Webster G, Williamson M, Kirschner J (2004) Alien plants in checklists and floras: towards better communication between taxonomists and ecologists. Taxon 53: 131–143. doi: 10.2307/4135498

Pyšek P, Sádlo J, Mandák B (2002) Catalogue of alien plants of the Czech Republic. Preslia 74: 97–186.

Raghu S, Anderson RC, Daehler CC, Davis AS, Widenmann RN, Simberloff D, Mack R (2006) Adding biofuels to the invasive species fire? Science 313: 1742. doi: 10.1126/science.1129313

Rejmánek M, Pitcairn MJ (2002) When is eradication of exotic pest plants a realistic goal? In: Veitch CR, Clout MN (Eds) Turning the tide: the eradication of invasive species. IUCN, Gland and Cambridge, 249–253.

Ricciardi A, Hoopes MF, Marchetti MP, Lockwood JL (2013) Progress toward understanding the ecological impacts of nonnative species. Ecological Monographs 83: 263–282. doi: 10.1890/13-0183.1

Ricciardi A, Steiner WW, Mack RN, Simberloff D (2000) Toward a global information system for invasive species. Bioscience 50: 239–244. doi: 10.1641/0006-3568(2000)050[0239:TAGISF]2.3.CO;2

Richardson DM, Pyšek P (2012) Naturalization of introduced plants: ecological drivers of biogeographic patterns. New Phytologist 196: 383–396. doi: 10.1111/j.1469-8137.2012.04292.x

Richardson DM, Pyšek P, Rejmánek M, Barbour MG, Panetta FD, West CJ (2000) Naturalization and invasion of alien plants: concepts and definitions. Diversity and Distributions 6: 93–107. doi: 10.1046/j.1472-4642.2000.00083.x

Richardson DM, Rejmánek M (2011) Trees and shrubs as invasive alien species: a global review. Diversity and Distributions 17: 788–809. doi: 10.1111/j.1472-4642.2011.00782.x

Roques A, Auger-Rozenberg MA (2006) Tentative analysis of the interceptions of non-indigenous organisms in Europe during 1995–2004. EPPO Bulletin 36: 490–496. doi: 10.1111/j.1365-2338.2006.01049.x

Scalera R, Genovesi P, De Man D et al. (2012) European code of conduct on Zoological gardens and aquaria and Invasive Alien Species. Council of Europe document T-PVS/Inf (2011) 26 rev., Strassbourg.

Šefrová H (2005) Introduced and invasive insect species in the Czech Republic and their economic and ecological impact (Insecta). Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis 53(5): 151–158. doi: 10.11118/actaun200553050151

Šefrová H, Laštůvka Z (2005) Catalogue of alien animal species in the Czech Republic. Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis 53(4): 151–170. doi: 10.11118/actaun200553040151

Shine C, Kettunen M, Genovesi P, Gollasch S, Pagad S, Starfinger U (2009) Technical support to EU Strategy on Invasive Species (IAS) – Policy options to control the negative impacts of IAS on biodiversity in Europe and the EU (Final module report for the European Commission). Institute for European Environmental Policy (IEEP), Brussels, Belgium.

Simberloff D, Genovesi P, Pyšek P, Campbell K (2011) Recognizing conservation success. Science 332: 419. doi: 10.1126/science.332.6028.419-a

Smith LL, Allen DJ, Barney J (2015) The thin green line: sustainable bioenergy feedstocks or invaders in waiting. NeoBiota 25: 47–71. doi: 10.3897/neobiota.25.8613

Svoboda J, Strand DA, Vrålstad T, Grandjean F, Edsman L, Kozák P, Kouba A, Fristad RF, Bahadir Koca S, Petrusek A (2014) The crayfish plague pathogen can infect freshwater-inhabiting crabs. Freshwater Biology 59: 918–929. doi: 10.1111/fwb.12315

Vaes-Petignat S, Nentwig W (2014) Environmental and economic impact of alien terrestrial arthropods in Europe. NeoBiota 22: 23–42. doi: 10.3897/neobiota.22.6620

van Kleunen M, Dawson W, Essl F, Pergl J, Winter M, Weber E, Kreft H, Weigelt P, Kartesz J, Nishino M, Antonova LA, Barcelona JF, Cabezas FJ, Cárdenas D, Cárdenas-Toro J, Castaño N, Chacón E, Chatelain C, Ebel AL, Figueiredo E, Fuentes N, Groom QJ, Henderson L, Inderjit, Kupriyanov A, Masciadri S, Meerman J, Morozova O, Moser D, Nickrent DL, Patzelt A, Pelser PB, Baptiste MP, Poopath M, Schulze M, Seebens H, Shu W, Thomas J, Velayos M, Wieringa JJ, Pyšek P (2015) Global exchange and accumulation of non-native plants. Nature 525: 100–103. doi: 10.1038/nature14910

Verbrugge LN, van der Velde G, Hendriks AJ, Verreycken H, Leuven R (2012) Risk classifications of aquatic non-native species: application of contemporary European assessment protocols in different biogeographical settings. Aquatic Invasions 7: 49–58. doi: 10.3391/ai.2012.7.1.006

Vilà M, Basnou C, Pyšek P, Josefsson M, Genovesi P, Gollasch S, Nentwig W, Olenin S, Roques A, Roy D, Hulme PE, DAISIE partners (2010) How well do we understand the impacts of alien species on ecosystem services? A pan-European, cross-taxa assessment. Frontiers in Ecology and the Environment 8: 135–144. doi: 10.1890/080083

Vilà M, Espinar JL, Hejda M, Hulme PE, Jarošík V, Maron JL, Pergl J, Schaffner U, Sun Y, Pyšek P (2011) Ecological impacts of invasive alien plants: a meta-analysis of their effects on species, communities and ecosystems. Ecology Letters 14: 702–708. doi: 10.1111/j.1461-0248.2011.01628.x

Williamson M, Pyšek P, Jarošík V, Prach K (2005) On the rates and patterns of spread of alien plants in the Czech Republic, Britain and Ireland. Ecoscience 12: 424–433. doi: 10.2980/i1195-6860-12-3-424.1

Wittenberg R, Cock MJ (2001) Invasive alien species: a toolkit of best prevention and management practices. CABI Publishing, Wallingford, 240 pp.

Woziwoda B, Potocki M, Sagan J, Zasada M, Tomusiak R, Wilczyński S (2014) Commercial forestry as a vector of alien tree species – the case of *Quercus rubra* L. introduction in Poland. Baltic Forestry 20: 131–141.

Appendix

Table A1. List of species in the groups of Black (BL) and Grey (GL) Lists. For plants, life history is shown: a – annual, b – biennial, pe – perennial, s – shrub, t – tree, aq – aquatic, p – parasitic. Plant species marked by * may be tolerated outside nature valuable areas. Economically important species where replacement by native species or keeping in controlled conditions (e.g. fishponds, enclosures) is recommended, are marked by (+).

Taxon group	List categ.	Species (scientific name)	Czech name	Family	Environment	Life history/ taxon group	Note	Mode of current spread	Distribution	Environmental impact	Human (socio-economic) impact	Management strategy
plant	BL1	*Ambrosia artemisiifolia* L.	ambrozie peřenolistá	Asteraceae	terrestrial	a		Spontaneous	Local	Moderate	Massive	Complete eradication
plant	BL1	*Heracleum mantegazzianum* Sommier et Levier	bolševník velkolepý	Apiaceae	terrestrial	b pe		Spontaneous	Regional	Massive	Massive	Complete eradication
animal	BL1	*Neovison vison* (Schreber, 1777)	norek americký	Mustelidae	terrestrial (aquatic)	mammal		Spontaneous	Regional	Moderate	Limited	Complete eradication
animal	BL1	*Procyon lotor* (Linnaeus, 1758)	mýval severní	Procyonidae	terrestrial (aquatic)	mammal		Spontaneous	Regional	Moderate	Limited	Complete eradication
animal	BL1	*Varroa destructor* (Anderson & Trueman, 2000)	kleštík zhoubný	Varroidae	terrestrial	invertebrate		Spontaneous	Regional	Limited	Massive	Complete eradication
plant	BL2	*Acer negundo* L.	javor jasanolistý	Sapindaceae	terrestrial	t		Released/spontaneous	Regional	Massive	Limited	Stratified approach
plant	BL2	*Ailanthus altissima* (Mill.) Swingle	pajasan žláznatý	Simaroubaceae	terrestrial	t		Released/spontaneous	Regional	Massive	Limited	Stratified approach
plant	BL2	*Allium paradoxum* (M. Bieb.) G. Don	česnek podivný	Amaryllidaceae	terrestrial	pe		Released/spontaneous	Regional	Moderate	Limited	Stratified approach
plant	BL2	*Amorpha fruticosa* L.	netvařec křovitý	Fabaceae	terrestrial	s		Released/spontaneous	Regional	Moderate	Limited	Stratified approach
plant	BL2	*Arrhenatherum elatius* (L.) J. Presl et C. Presl	ovsík vyvýšený	Poaceae	terrestrial	pe		Released/spontaneous	Regional	Moderate	Limited	Stratified approach
plant	BL2	*Asclepias syriaca* L.	klejicha hedvábná, k. vatočník	Apocynaceae	terrestrial	pe		Released/spontaneous	Local	Moderate	Limited	Stratified approach
plant	BL2	*Azolla filiculoides* Lam.	azola americká	Salviniaceae	aquatic	a f aq		Released/spontaneous	Regional	Moderate	Limited	Stratified approach
plant	BL2	*Beta vulgaris* Altissima Group	řepa obecná cukrovka	Amaranthaceae	terrestrial	b a		Released	Regional	Limited	Moderate	Stratified approach
plant	BL2	*Buddleja davidii* Franch.	komule Davidova	Scrophulariaceae	terrestrial	s		Released/spontaneous	Regional	Moderate	Limited	Stratified approach
plant	BL2	*Colutea arborescens* L.	žanovec měchýřník	Fabaceae	terrestrial	s		Released/spontaneous	Regional	Moderate	Limited	Stratified approach
plant	BL2	*Cornus sericea* L. et *C. alba* L.	svída výběžkatá	Cornaceae	terrestrial	s		Released/spontaneous	Regional	Moderate	Limited	Stratified approach

Taxon group	List categ.	Species (scientific name)	Czech name	Family	Environment	Life history/ taxon group	Note	Mode of current spread	Distribution	Environmental impact	Human (socio-economic) impact	Management strategy
plant	BL2	*Cytisus scoparius* (L.) Link subsp. *scoparius*	janovec metlatý pravý	Fabaceae	terrestrial	s		Released/spontaneous	Regional	Moderate	Limited	Stratified approach
plant	BL2	*Echinocystis lobata* (Michx.) Torr. et A. Gray	štětinec laločnatý	Cucurbitaceae	terrestrial	a		Released/spontaneous	Regional	Moderate	Limited	Stratified approach
plant	BL2	*Echinops exaltatus* Schrad.	bělotrn statný	Asteraceae	terrestrial	pe		Released/spontaneous	Regional	Moderate	Limited	Stratified approach
plant	BL2	*Echinops sphaerocephalus* L. subsp. *sphaerocephalus*	bělotrn kulatohlavý pravý	Asteraceae	terrestrial	pe		Released/spontaneous	Local	Moderate	Limited	Stratified approach
plant	BL2	*Fallopia aubertii* (L. Henry) Holub	opletka čínská	Polygonaceae	terrestrial	s		Released	Regional	Moderate	Limited	Stratified approach
plant	BL2	*Fraxinus pennsylvanica* Marshall	jasan pensylvánský	Oleaceae	terrestrial	t		Released/spontaneous	Regional	Massive	Limited	Stratified approach
plant	BL2	*Galega officinalis* L.	jestřabina lékařská	Fabaceae	terrestrial	pe		Released/spontaneous	Regional	Moderate	Limited	Stratified approach
plant	BL2	*Galeobdolon argentatum* Smejkal	pitulník postříbřený	Lamiaceae	terrestrial	pe		Released/spontaneous	Regional	Moderate	Limited	Stratified approach
plant	BL2	*Helianthus ×laetiflorus* Pers.	slunečnice pozdní	Asteraceae	terrestrial	pe		Released/spontaneous	Regional	Moderate	Limited	Stratified approach
plant	BL2	*Helianthus pauciflorus* Nutt.	slunečnice tuhá	Asteraceae	terrestrial	pe		Released/spontaneous	Regional	Moderate	Limited	Stratified approach
plant	BL2	*Helianthus tuberosus* L.	slunečnice topinambur	Asteraceae	terrestrial	pe		Released/spontaneous	Regional	Massive	Limited	Stratified approach
plant	BL2	*Impatiens glandulifera* Royle	netýkavka žláznatá	Balsaminaceae	terrestrial	a		Released/spontaneous	Regional	Moderate	Limited	Stratified approach
plant	BL2	*Laburnum anagyroides* Medik.	štědřenec odvislý	Fabaceae	terrestrial	s t	incl. *L. x watereri* (Wettst.) Dippel, *L. alpinum* (Mill.) J. Presl	Released/spontaneous	Regional	Moderate	Limited	Stratified approach
plant	BL2	*Lupinus polyphyllus* Lindl.	lupina mnoholistá, vlčí bob mnoholistý	Fabaceae	terrestrial	pe		Released/spontaneous	Regional	Moderate	Limited	Stratified approach
plant	BL2	*Lycium barbarum* L.	kustovnice cizí	Solanaceae	terrestrial	s	*	Released	Regional	Moderate	Limited	Stratified approach
plant	BL2	*Parthenocissus inserta* (A. Kern.) Fritsch	loubinec popínavý	Vitaceae	terrestrial	s		Released/spontaneous	Regional	Massive	Limited	Stratified approach
plant	BL2	*Parthenocissus quinquefolia* (L.) Planch.	loubinec pětilistý	Vitaceae	terrestrial	s		Released/spontaneous	Regional	Moderate	Limited	Stratified approach
plant	BL2	*Physocarpus opulifolius* (L.) Maxim.	tavola kalinolistá	Rosaceae	terrestrial	s		Released/spontaneous	Regional	Moderate	Limited	Stratified approach
plant	BL2	*Phytolacca esculenta* Van Houtte	líčidlo jedlé	Phytolaccaceae	terrestrial	pe		Released/spontaneous	Regional	Moderate	Limited	Stratified approach

Taxon group	List categ.	Species (scientific name)	Czech name	Family	Environment	Life history/ taxon group	Note	Mode of current spread	Distribution	Environmental impact	Human (socio-economic) impact	Management strategy
plant	BL2	*Pinus nigra* J. F. Arnold subsp. *nigra*	borovice černá pravá	Pinaceae	terrestrial	t		Released/spontaneous	Local	Moderate	Limited	Stratified approach
plant	BL2	*Pinus strobus* L.	borovice vejmutovka, vejmutovka	Pinaceae	terrestrial	t		Released/spontaneous	Local	Massive	Limited	Stratified approach
plant	BL2	*Populus ×canadensis* Moench	topol kanadský	Salicaceae	terrestrial	t	*	Released/spontaneous	Regional	Massive	Limited	Stratified approach
plant	BL2	*Populus balsamifera* L.	topol balzámový	Salicaceae	terrestrial	t		Released/spontaneous	Regional	Moderate	Limited	Stratified approach
plant	BL2	*Prunus cerasifera* Ehrh.	slivoň myrobalán, myrobalán	Rosaceae	terrestrial	t s	*	Released/spontaneous	Regional	Massive	Limited	Stratified approach
plant	BL2	*Prunus serotina* Ehrh.	střemcha pozdní	Rosaceae	terrestrial	t s		Released/spontaneous	Regional	Massive	Limited	Stratified approach
plant	BL2	*Pyracantha coccinea* M. J. Roem.	hlohyně šarlatová	Rosaceae	terrestrial	s t		Released/spontaneous	Local	Moderate	Limited	Stratified approach
plant	BL2	*Quercus rubra* L.	dub červený	Fagaceae	terrestrial	t		Released/spontaneous	Regional	Massive	Limited	Stratified approach
plant	BL2	*Reynoutria ×bohemica* Chrtek et Chrtková	křídlatka česká	Polygonaceae	terrestrial	pe		Released/spontaneous	Regional	Massive	Limited	Stratified approach
plant	BL2	*Reynoutria japonica* Houtt. var. *japonica*	křídlatka japonská pravá	Polygonaceae	terrestrial	pe		Released/spontaneous	Regional	Massive	Limited	Stratified approach
plant	BL2	*Reynoutria sachalinensis* (F. Schmidt) Nakai	křídlatka sachalinská	Polygonaceae	terrestrial	pe		Released/spontaneous	Regional	Massive	Limited	Stratified approach
plant	BL2	*Rhus typhina* (L.) Sudw.	škumpa orobincová	Anacardiaceae	terrestrial	s t		Released	Regional	Moderate	Limited	Stratified approach
plant	BL2	*Robinia pseudoacacia* L.	trnovník akát, akát	Fabaceae	terrestrial	t	*	Released/spontaneous	Regional	Massive	Limited	Stratified approach
plant	BL2	*Rudbeckia laciniata* L.	třapatka dřípatá	Asteraceae	terrestrial	pe		Released/spontaneous	Regional	Moderate	Limited	Stratified approach
plant	BL2	*Solidago canadensis* L.	zlatobýl kanadský	Asteraceae	terrestrial	pe		Released/spontaneous	Regional	Massive	Limited	Stratified approach
plant	BL2	*Solidago gigantea* Aiton	zlatobýl obrovský	Asteraceae	terrestrial	pe		Released/spontaneous	Regional	Massive	Limited	Stratified approach
plant	BL2	*Symphoricarpos albus* (L.) S. F. Blake	pámelník bílý	Caprifoliaceae	terrestrial	s		Released	Regional	Moderate	Limited	Stratified approach
plant	BL2	*Symphyotrichum novi-belgii* (L.) G. L. Nesom	astřička novobelgická, hvězdnice novobelgická	Asteraceae	terrestrial	pe	incl. all other closely related hybrids in this taxon complex (e.g. *S. lanceolatum*)	Released/spontaneous	Regional	Massive	Limited	Stratified approach

Taxon group	List categ.	Species (scientific name)	Czech name	Family	Environment	Life history/ taxon group	Note	Mode of current spread	Distribution	Environmental impact	Human (socio-economic) impact	Management strategy
plant	BL2	*Telekia speciosa* (Schreb.) Baumg.	kolotočník ozdobný	Asteraceae	terrestrial	pe		Released/spontaneous	Regional	Moderate	Limited	Stratified approach
animal	BL2	*Cervus nippon* Temminck, 1838	jelen sika	Cervidae	terrestrial	mammal	+	Released/spontaneous	Regional	Moderate	Limited	Stratified approach
animal	BL2	*Ctenopharyngodon idella* (Valenciennes, 1844)	amur bílý	Cyprinidae	aquatic	fish		Released	Regional	Moderate	Limited	Stratified approach
animal	BL2	*Hypophthalmichthys molitrix* (Valenciennes, 1844)	tolstolobik bílý	Cyprinidae	aquatic	fish		Released	Regional	Moderate	Limited	Stratified approach
animal	BL2	*Hypophthalmichthys nobilis* (Richardson, 1845)	tolstolobik pestrý	Cyprinidae	aquatic	fish		Released	Regional	Moderate	Limited	Stratified approach
animal	BL2	*Micropterus salmoides* (Lacépède, 1802)	okounek pstruhový	Centrarchidae	aquatic	fish		Released	Local	Limited	Limited	Stratified approach
animal	BL2	*Oncorhynchus mykiss* (Walbaum, 1792)	pstruh duhový	Salmonidae	aquatic	fish	+	Released	Regional	Limited	Limited	Stratified approach
animal	BL2	*Ovis musimon* (Pallas, 1811)	muflon	Bovidae	terrestrial	mammal	+	Released/spontaneous	Regional	Limited	Limited	Stratified approach
animal	BL2	*Salvelinus fontinalis* (Mitchill, 1815)	siven americký	Salmonidae	aquatic	fish	+	Released/spontaneous	Regional	Limited	Limited	Stratified approach
plant	BL3	*Abutilon theophrasti* Medik.	mračňák Theophrastův	Malvaceae	terrestrial	a		Spontaneous	Local	Limited	Moderate	Stratified approach
plant	BL3	*Alopecurus myosuroides* Huds.	psárka polní	Poaceae	terrestrial	a		Spontaneous	Regional	Moderate	Moderate	Stratified approach
plant	BL3	*Amaranthus albus* L.	laskavec bílý	Amaranthaceae	terrestrial	a		Spontaneous	Local	Limited	Moderate	Stratified approach
plant	BL3	*Amaranthus powellii* S. Watson	laskavec zelenoklasý	Amaranthaceae	terrestrial	a		Spontaneous	Regional	Moderate	Moderate	Stratified approach
plant	BL3	*Amaranthus retroflexus* L.	laskavec ohnutý, l. srstnatý	Amaranthaceae	terrestrial	a		Spontaneous	Regional	Moderate	Moderate	Stratified approach
plant	BL3	*Bunias orientalis* L.	rukevník východní	Brassicaceae	terrestrial	b pe		Spontaneous	Regional	Massive	Limited	Stratified approach
plant	BL3	*Cannabis sativa* var. *spontanea* Vavilov	konopí seté rumištní	Cannabaceae	terrestrial	a		Spontaneous	Regional	Moderate	Moderate	Stratified approach
plant	BL3	*Cirsium arvense* (L.) Scop.	pcháč oset	Asteraceae	terrestrial	pe		Spontaneous	Regional	Moderate	Moderate	Stratified approach
plant	BL3	*Conium maculatum* L.	bolehlav plamatý	Apiaceae	terrestrial	a b		Spontaneous	Regional	Moderate	Moderate	Stratified approach
plant	BL3	*Consolida hispanica* (Costa) Greuter et Burdet	ostrožka východní	Ranunculaceae	terrestrial	a		Spontaneous	Regional	Limited	Moderate	Stratified approach
plant	BL3	*Conyza canadensis* (L.) Cronquist	turanka kanadská, turan kanadský	Asteraceae	terrestrial	a		Spontaneous	Regional	Moderate	Moderate	Stratified approach

Taxon group	List categ.	Species (scientific name)	Czech name	Family	Environment	Life history/ taxon group	Note	Mode of current spread	Distribution	Environmental impact	Human (socio-economic) impact	Management strategy
plant	BL3	*Cuscuta campestris* Yunck.	kokotice ladní	Convolvulaceae	terrestrial	a		Spontaneous	Local	Moderate	Moderate	Stratified approach
plant	BL3	*Digitaria ischaemum* (Schreb.) Muhl.	rosička lysá	Poaceae	terrestrial	a		Spontaneous	Regional	Moderate	Moderate	Stratified approach
plant	BL3	*Echinochloa crus-galli* (L.) P. Beauv.	ježatka kuří noha	Poaceae	terrestrial	a		Spontaneous	Regional	Moderate	Moderate	Stratified approach
plant	BL3	*Galinsoga parviflora* Cav.	pěťour malokvětý	Asteraceae	terrestrial	a		Spontaneous	Regional	Limited	Moderate	Stratified approach
plant	BL3	*Galinsoga quadriradiata* Ruiz et Pav.	pěťour srstnatý	Asteraceae	terrestrial	a		Spontaneous	Regional	Limited	Moderate	Stratified approach
plant	BL3	*Iva xanthiifolia* Nutt.	pouva řepňolistá	Asteraceae	terrestrial	a		Spontaneous	Local	Moderate	Moderate	Stratified approach
plant	BL3	*Orobanche minor* Sm.	záraza menší	Orobanchaceae	terrestrial	b pe p		Spontaneous	Regional	Moderate	Moderate	Stratified approach
plant	BL3	*Oxalis corniculata* L. var. *corniculata*	šťavel růžkatý pravý	Oxalidaceae	terrestrial	a b pe		Spontaneous	Regional	Limited	Moderate	Stratified approach
plant	BL3	*Oxalis dillenii* Jacq.	šťavel prérijní	Oxalidaceae	terrestrial	a b pe		Spontaneous	Regional	Limited	Moderate	Stratified approach
plant	BL3	*Panicum miliaceum* subsp. *agricola* H. Scholz et Mikoláš	proso seté polní	Poaceae	terrestrial	a	*incl.* subsp. *ruderale* (Kitag.) Tzvelev	Spontaneous	Local	Moderate	Moderate	Stratified approach
plant	BL3	*Portulaca oleracea* L. subsp. *oleracea*	šrucha zelná pravá	Portulacaceae	terrestrial	a		Spontaneous	Regional	Limited	Moderate	Stratified approach
plant	BL3	*Rumex alpinus* L.	šťovík alpský	Polygonaceae	terrestrial	pe		Spontaneous	Local	Massive	Limited	Stratified approach
plant	BL3	*Rumex longifolius* subsp. *sourekii* Kubát	šťovík dlouholistý Šourkův	Polygonaceae	terrestrial	pe		Spontaneous	Local	Limited	Limited	Stratified approach
plant	BL3	*Senecio inaequidens* DC.	starček úzkolistý	Asteraceae	terrestrial	pe		Spontaneous	Regional	Massive	Limited	Stratified approach
plant	BL3	*Setaria faberi* R. A. W. Herrm.	bér ohnutý	Poaceae	terrestrial	a		Spontaneous	Regional	Moderate	Moderate	Stratified approach
plant	BL3	*Setaria verticillata* (L.) P. Beauv.	bér přeslenitý	Poaceae	terrestrial	a		Spontaneous	Regional	Moderate	Moderate	Stratified approach
animal	BL3	*Ameiurus melas* (Rafinesque, 1820)	sumeček černý	Ictaluridae	aquatic	fish		Spontaneous	Local	Moderate	Limited	Stratified approach
animal	BL3	*Anguillicoloides crassus* Kuwah., Niimi & Itagaki, 1974	krevnatka úhoří	Anguillicolidae	aquatic	invertebrate		Spontaneous	Regional	Moderate	Moderate	Stratified approach
animal	BL3	*Arion vulgaris* Moquin-Tandon, 1855	plzák španělský	Arionidae	terrestrial	invertebrate		Spontaneous	Regional	Moderate	Massive	Stratified approach
animal	BL3	*Cameraria ohridella* Deschka & Dimic, 1986	klíněnka jírovcová	Gracillariidae	terrestrial	invertebrate		Spontaneous	Regional	Limited	Moderate	Stratified approach
animal	BL3	*Carassius gibelio* (Bloch, 1782)	karas stříbřitý	Cyprinidae	aquatic	fish		Spontaneous	Regional	Massive	Moderate	Stratified approach
animal	BL3	*Carassius langsdorfii* Temminck & Schlegel, 1846	karas ginbuna	Cyprinidae	aquatic	fish		Spontaneous	Regional	Moderate	Moderate	Stratified approach

Taxon group	List categ.	Species (scientific name)	Czech name	Family	Environment	Life history/ taxon group	Note	Mode of current spread	Distribution	Environmental impact	Human (socio-economic) impact	Management strategy
animal	BL3	*Corbicula fluminea* (O. F. Müller, 1774)	korbikula asijská	Cyrenidae	aquatic	invertebrate		Spontaneous	Regional	Moderate	Limited	Stratified approach
animal	BL3	*Diaspidiotus perniciosus* (Comstock, 1881)	štítenka zhoubná	Diaspididae	terrestrial	invertebrate		Spontaneous	Regional	Limited	Moderate	Stratified approach
animal	BL3	*Dikerogammarus villosus* (Sowinsky, 1894)	blešivec ježatý	Gammaridae	aquatic	invertebrate		Spontaneous	Regional	Massive	Limited	Stratified approach
animal	BL3	*Dreissena polymorpha* (Pallas, 1771)	slávička mnohotvárná	Dreissenidae	aquatic	invertebrate		Spontaneous	Regional	Massive	Moderate	Stratified approach
animal	BL3	*Eriosoma lanigerum* (Hausmann, 1802)	vlnatka krvavá	Aphididae	terrestrial	invertebrate		Spontaneous	Regional	Limited	Moderate	Stratified approach
animal	BL3	*Harmonia axyridis* (Pallas, 1773)	slunéčko východní	Coccinellidae	terrestrial	invertebrate		Spontaneous	Regional	Moderate	Moderate	Stratified approach
animal	BL3	*Hyphantria cunea* (Drury, 1773)	přástevníček americký	Arctiidae	terrestrial	invertebrate		Spontaneous	Local	Limited	Limited	Stratified approach
animal	BL3	*Khawia sinensis* Hsü, 1935	tasemnice	Lytocestidae	terrestrial	invertebrate		Spontaneous	Regional	Limited	Limited	Stratified approach
animal	BL3	*Lepomis gibbosus* (Linnaeus, 1758)	slunečnice pestrá	Centrarchidae	aquatic	fish		Spontaneous	Regional	Moderate	Limited	Stratified approach
animal	BL3	*Mus musculus / M. domesticus* Linnaeus, 1758	myš domácí/m. západoevropská	Muridae	terrestrial	mammal		Spontaneous	Regional	Limited	Massive	Stratified approach
animal	BL3	*Myocastor coypus* (Molina, 1782)	nutrie říční	Myocastoridae	terrestrial (aquatic)	mammal		Released/spontaneous	Regional	Limited	Limited	Stratified approach
animal	BL3	*Neogobius melanostomus* (Pallas, 1814)	hlaváč černotlamý	Gobiidae	aquatic	fish		Spontaneous	Regional	Moderate	Limited	Stratified approach
animal	BL3	*Nyctereutes procyonoides* (Gray, 1834)	psík mývalovitý	Canidae	terrestrial (aquatic)	mammal		Spontaneous	Regional	Limited	Limited	Stratified approach
animal	BL3	*Ondatra zibethicus* (Linnaeus, 1766)	ondatra pižmová	Arvicolidae	terrestrial (aquatic)	mammal		Spontaneous	Regional	Limited	Limited	Stratified approach
animal	BL3	*Orconectes limosus* (Rafinesque, 1817)	rak pruhovaný	Cambaridae	aquatic	invertebrate		Spontaneous	Local	Massive	Limited	Stratified approach
animal	BL3	*Oxycarenus lavaterae* (Fabricius, 1787)	ploštička lipová	Oxycarenus	terrestrial	invertebrate		Spontaneous	Regional	Limited	Limited	Stratified approach
animal	BL3	*Pacifastacus leniusculus* (Dana, 1852)	rak signální	Astacidae	aquatic	invertebrate		Spontaneous	Local	Massive	Limited	Stratified approach
animal	BL3	*Pseudorasbora parva* (Temminck & Schlegel, 1846)	střevlička východní	Cyprinidae	aquatic	fish		Spontaneous	Regional	Massive	Moderate	Stratified approach
animal	BL3	*Rattus norvegicus* (Berkenhout, 1769)	potkan	Muridae	terrestrial	mammal		Spontaneous	Regional	Moderate	Massive	Stratified approach
animal	BL3	*Rattus rattus* (Linnaeus, 1758)	krysa obecná	Muridae	terrestrial	mammal		Spontaneous	Local	Limited	Moderate	Stratified approach

Taxon group	List categ.	Species (scientific name)	Czech name	Family	Environment	Life history/ taxon group	Note	Mode of current spread	Distribution	Environmental impact	Human (socio-economic) impact	Management strategy
animal	BL3	*Sinanodonta woodiana* (Lea, 1834)	škeble asijská	Unionidae	aquatic	invertebrate		Spontaneous	Local	Limited	Limited	Stratified approach
animal	BL3	*Trachemys scripta* (Thunberg in Schoepff, 1792)	želva nádherná	Emydidae	aquatic (terrestrial)	reptile		Released	Regional	Limited	Limited	Stratified approach
plant	GL	*Amelanchier spicata* (Lam.) K. Koch	muchovník klasnatý	Rosaceae	terrestrial	s		Released/spontaneous	Regional	Limited	Limited	Tolerance
plant	GL	*Angelica archangelica* L. subsp. *archangelica*	andělika lékařská, děhel lékařský	Apiaceae	terrestrial	b pe		Spontaneous	Regional	Limited	Limited	Tolerance
plant	GL	*Artemisia annua* L.	pelyněk roční	Asteraceae	terrestrial	a		Spontaneous	Regional	Limited	Limited	Tolerance
plant	GL	*Artemisia tournefortiana* Rchb.	pelyněk Tournefortův	Asteraceae	terrestrial	pe		Spontaneous	Regional	Limited	Limited	Tolerance
plant	GL	*Artemisia verlotiorum* Lamotte	pelyněk Verlotů	Asteraceae	terrestrial	pe		Spontaneous	Regional	Limited	Limited	Tolerance
plant	GL	*Atriplex sagittata* Borkh.	lebeda lesklá	Amaranthaceae	terrestrial	a		Spontaneous	Regional	Limited	Limited	Tolerance
plant	GL	*Bassia scoparia* (L.) Voss subsp. *scoparia*	bytel metlatý pravý	Amaranthaceae	terrestrial	a	*incl. Bassia scoparia* subsp. *densiflora* (B. D. Jacks.) Ciruja et Velayos	Spontaneous	Regional	Limited	Limited	Tolerance
plant	GL	*Bidens frondosus* L.	dvouzubec černoplodý	Asteraceae	terrestrial	a		Spontaneous	Regional	Limited	Limited	Tolerance
plant	GL	*Bromus carinatus* Hook. et Arn	sveřep kýlnatý	Poaceae	terrestrial	a pe		Spontaneous	Regional	Limited	Limited	Tolerance
plant	GL	*Bryonia dioica* Jacq.	posed dvoudomý	Cucurbitaceae	terrestrial	pe		Spontaneous	Regional	Limited	Limited	Tolerance
plant	GL	*Centaurea diffusa* Lam.	chrpa rozkladitá	Asteraceae	terrestrial	a		Spontaneous	Regional	Limited	Limited	Tolerance
plant	GL	*Corispermum pallasii* Steven	velbloudník tenkokřídlý	Amaranthaceae	terrestrial	a		Spontaneous	Local	Limited	Limited	Tolerance
plant	GL	*Dipsacus strigosus* Willd. ex Roem. et Schult.	štětka větší	Dipsacaceae	terrestrial	b		Released/spontaneous	Regional	Limited	Limited	Tolerance
plant	GL	*Dittrichia graveolens* (L.) Greuter	oman smradlavý	Asteraceae	terrestrial	a		Spontaneous	Regional	Limited	Limited	Tolerance
plant	GL	*Duchesnea indica* (Jacks.) Focke	jahodka indická	Rosaceae	terrestrial	pe		Released/spontaneous	Regional	Limited	Limited	Tolerance
plant	GL	*Dysphania pumilio* (R. Br.) Mosyakin et Clemants	merlík trpasličí	Amaranthaceae	terrestrial	a		Spontaneous	Regional	Limited	Limited	Tolerance
plant	GL	*Eragrostis minor* Host	milička menší	Poaceae	terrestrial	a		Spontaneous	Regional	Limited	Limited	Tolerance
plant	GL	*Erechtites hieraciifolius* (L.) DC.	starčkovec jestřábníkolistý	Asteraceae	terrestrial	pe		Spontaneous	Regional	Limited	Limited	Tolerance

Taxon group	List categ.	Species (scientific name)	Czech name	Family	Environment	Life history/ taxon group	Note	Mode of current spread	Distribution	Environmental impact	Human (socio-economic) impact	Management strategy
plant	GL	*Erigeron annuus* (L.) Desf. subsp. *annuus*	turan roční pravý	Asteraceae	terrestrial	a	*incl. Erigeron annuus* subsp. *septentrionalis* (Fernald et Wiegand) Wagenitz	Spontaneous	Regional	Limited	Limited	Tolerance
plant	GL	*Erigeron strigosus* Muhl. ex Willd.	turan větevnatý	Asteraceae	terrestrial	a pe		Spontaneous	Regional	Limited	Limited	Tolerance
plant	GL	*Erucastrum gallicum* (Willd.) O. E. Schulz	ředkevník galský	Brassicaceae	terrestrial	a b		Spontaneous	Regional	Limited	Limited	Tolerance
plant	GL	*Erucastrum nasturtiifolium* (Poir.) O. E. Schulz	ředkevník potočnicolistý	Brassicaceae	terrestrial	b pe		Spontaneous	Regional	Limited	Limited	Tolerance
plant	GL	*Geranium sibiricum* L.	kakost sibiřský	Geraniaceae	terrestrial	pe		Spontaneous	Regional	Limited	Limited	Tolerance
plant	GL	*Hordeum jubatum* L.	ječmen hřívnatý	Poaceae	terrestrial	a		Released/spontaneous	Regional	Limited	Limited	Tolerance
plant	GL	*Chenopodium striatiforme* J. Murr	merlík drobnolistý	Amaranthaceae	terrestrial	a		Spontaneous	Regional	Limited	Limited	Tolerance
plant	GL	*Impatiens parviflora* DC.	netýkavka malokvětá	Balsaminaceae	terrestrial	a		Spontaneous	Regional	Limited	Limited	Tolerance
plant	GL	*Juglans regia* L.	ořešák královský	Juglandaceae	terrestrial	t		Released/spontaneous	Regional	Limited	Limited	Tolerance
plant	GL	*Lemna turionifera* Landolt	okřehek červený	Araceae	aquatic	a pe aq		Spontaneous	Regional	Limited	Limited	Tolerance
plant	GL	*Lepidium densiflorum* Schrad.	řeřicha hustokvětá	Brassicaceae	terrestrial	a b		Spontaneous	Regional	Limited	Limited	Tolerance
plant	GL	*Lepidium virginicum* L.	řeřicha virginská	Brassicaceae	terrestrial	a b		Spontaneous	Regional	Limited	Limited	Tolerance
plant	GL	*Lonicera caprifolium* L.	zimolez kozí list	Caprifoliaceae	terrestrial	s		Released/spontaneous	Regional	Limited	Limited	Tolerance
plant	GL	*Lunaria annua* L.	měsíčnice roční	Brassicaceae	terrestrial	b		Spontaneous	Regional	Limited	Limited	Tolerance
plant	GL	*Mahonia aquifolium* (Pursh) Nutt.	mahónie cesmínolistá	Berberidaceae	terrestrial	s		Released/spontaneous	Regional	Limited	Limited	Tolerance
plant	GL	*Melissa officinalis* (L.) Lam. subsp. *officinalis*	meduňka lékařská pravá	Lamiaceae	terrestrial	pe		Released/spontaneous	Regional	Limited	Limited	Tolerance
plant	GL	*Oenothera glazioviana* Micheli	pupalka rudokališní	Onagraceae	terrestrial	b		Released/spontaneous	Regional	Limited	Limited	Tolerance
plant	GL	*Oenothera pycnocarpa* G. F. Atk. et Bartlett	pupalka chicagská	Onagraceae	terrestrial	a b		Spontaneous	Regional	Limited	Limited	Tolerance
plant	GL	*Oenothera rubricaulis* Kleb.	pupalka červenostonká	Onagraceae	terrestrial	b		Spontaneous	Regional	Limited	Limited	Tolerance

Taxon group	List categ.	Species (scientific name)	Czech name	Family	Environment	Life history/ taxon group	Note	Mode of current spread	Distribution	Environmental impact	Human (socio-economic) impact	Management strategy
plant	GL	*Rubrivena polystachya* (Wall. ex Meisn.) M. Král	rdesno mnohoklasé	Polygonaceae	terrestrial	pe		Spontaneous	Regional	Limited	Limited	Tolerance
plant	GL	*Rumex triangulivalvis* (Danser) Rech. f.	šťovík trojmozolný	Polygonaceae	terrestrial	pe		Spontaneous	Regional	Limited	Limited	Tolerance
plant	GL	*Sagittaria latifolia* Willd.	šípatka širolistá	Alismataceae	aquatic	pe aq		Released/spontaneous	Regional	Limited	Limited	Tolerance
plant	GL	*Scutellaria altissima* L.	šišák vysoký	Lamiaceae	terrestrial	pe		Spontaneous	Regional	Limited	Limited	Tolerance
plant	GL	*Sedum hispanicum* L.	rozchodník španělský	Crassulaceae	terrestrial	pe		Released/spontaneous	Regional	Limited	Limited	Tolerance
plant	GL	*Senecio vernalis* Waldst. et Kit.	starček jarní	Asteraceae	terrestrial	a		Spontaneous	Regional	Limited	Limited	Tolerance
plant	GL	*Sisymbrium loeselii* L.	hulevník Loeselův	Brassicaceae	terrestrial	a		Spontaneous	Regional	Limited	Limited	Tolerance
plant	GL	*Solanum decipiens* Opiz	lilek vlnatý	Solanaceae	terrestrial	a		Spontaneous	Regional	Limited	Limited	Tolerance
plant	GL	*Stellaria pallida* (Dumort.) Crép.	ptačinec bledý	Caryophyllaceae	terrestrial	a		Spontaneous	Regional	Limited	Limited	Tolerance
plant	GL	*Typha laxmannii* Lepech.	orobinec sítinovitý	Typhaceae	ne aquat??	pe		Released/spontaneous	Regional	Limited	Limited	Tolerance
animal	GL	*Ameiurus nebulosus* (Lesueur, 1819)	sumeček americký	Ictaluridae	aquatic	fish		Spontaneous	Regional	Limited	Limited	Tolerance
animal	GL	*Ashworthius sidemi* Schulz, 1933	vlasovka	Trichostrongylidae	terrestrial	invertebrate		Spontaneous	Regional	Limited	Limited	Tolerance
animal	GL	*Astacus leptodactylus* Eschscholtz, 1823	rak bahenní	Astacidae	aquatic	invertebrate		Spontaneous	Regional	Limited	Limited	Tolerance
animal	GL	*Dactylogyrus achmerowi* Gusev, 1955	žábrohlíst	Dactylogyridae	aquatic	invertebrate		Spontaneous	Regional	Limited	Limited	Tolerance
animal	GL	*Eriocheir sinensis* H. Milne Edwards, 1853	krab říční	Varunidae	aquatic	invertebrate		Spontaneous	Local	Limited	Limited	Tolerance
animal	GL	*Eudiplozoon nipponicum* (Goto, 1891)	žábrohlíst	Diplozoidae	aquatic	invertebrate		Spontaneous	Regional	Limited	Limited	Tolerance
animal	GL	*Fascioloides magna* (Bassi, 1875)	motolice obrovská	Fasciolidae	terrestrial	invertebrate		Spontaneous	Regional	Limited	Limited	Tolerance
animal	GL	*Gyrodactylus cyprini* Diarova, 1964	žábrohlíst	Gyrodactylidae	aquatic	invertebrate		Spontaneous	Regional	Limited	Limited	Tolerance
animal	GL	*Gyrodactylus kherulensis* Ergens, 1974	žábrohlíst	Gyrodactylidae	aquatic	invertebrate		Spontaneous	Regional	Limited	Limited	Tolerance
animal	GL	*Gyrodactylus shulmani* Ling, 1962	žábrohlíst	Gyrodactylidae	aquatic	invertebrate		Spontaneous	Regional	Limited	Limited	Tolerance
animal	GL	*Gyrodactylus sprostonae* Ling, 1962	žábrohlíst	Gyrodactylidae	aquatic	invertebrate		Spontaneous	Regional	Limited	Limited	Tolerance
animal	GL	*Chelicorophium curvispinum* Sars, 1895		Corophiidae	aquatic	invertebrate		Spontaneous	Local	Limited	Limited	Tolerance

Taxon group	List categ.	Species (scientific name)	Czech name	Family	Environment	Life history/ taxon group	Note	Mode of current spread	Distribution	Environmental impact	Human (socio-economic) impact	Management strategy
animal	GL	*Proteocephalus longicollis* (Zeder, 1800)	tasemnice	Proteocephalidae	terrestrial	invertebrate		Spontaneous	Regional	Limited	Limited	Tolerance
animal	GL	*Pseudodactylogyrus anguillae* (Yin & Sproston, 1948)	žábrohlíst	Ancyrocephalidae	aquatic	invertebrate		Spontaneous	Regional	Limited	Limited	Tolerance
animal	GL	*Pseudodactylogyrus bini* (Kikuchi, 1929)	žábrohlíst	Ancyrocephalidae	aquatic	invertebrate		Spontaneous	Regional	Limited	Limited	Tolerance
animal	GL	*Rupicapra rupicapra* (Linnaeus, 1758)	kamzík horský	Bovidae	terrestrial	mammal		Spontaneous	Local	Limited	Limited	Tolerance

Table A2. Watch list (WL) of plant and animal species. For plants life history is shown: a – annual, b – biennial, pe – perennial, s – shrub, t – tree, aq – aquatic.

Taxon group	List category	Species (scientific name)	Czech name	Family	Environment	Life history/ taxon group
plant	WL	*Aesculus hippocastanum* L.	jírovec maďal ("koňský kaštan")	Sapindaceae	terrestrial	t
plant	WL	*Agrostis scabra* Willd.	psineček řídkokvětý	Poaceae	terrestrial	pe
plant	WL	*Amaranthus crispus* (Lesp. & Thévenau) N. Terracc.	laskavec kadeřavý	Amaranthaceae	terrestrial	a
plant	WL	*Amaranthus deflexus* L.	laskavec skloněný	Amaranthaceae	terrestrial	pe
plant	WL	*Azolla filiculoides* Lamk.	azola americká	Salviniaceae	aquatic	a f aq
plant	WL	*Cardamine chelidonia* L.	řeřišnice vlaštovičníkovitá	Brassicaceae	terrestrial	a pe
plant	WL	*Cotoneaster* sp.	skalník	Rosaceae	terrestrial	s
plant	WL	*Elodea canadensis* Michx	vodní mor kanadský	Hydrocharitaceae	aquatic	a f aq
plant	WL	*Elodea nutalii* Planchon	vodní mor americký	Hydrocharitaceae	aquatic	a f aq
plant	WL	*Eragrostis pilosa* (L.) P. Beauv.	milička chlupatá	Poaceae	terrestrial	a
plant	WL	*Glyceria striata* (Lam.) Hitchc.	zblochan žíhaný	Poaceae	terrestrial	pe
plant	WL	*Heracleum persicum* Fisch.	bolševník perský	Apiaceae	terrestrial	b pe
plant	WL	*Heracleum sosnowskyi* Manden.	bolševník Sosnovského	Apiaceae	terrestrial	b pe
plant	WL	*Lathyrus aphaca* L.	hrachor pačočkový	Fabaceae	terrestrial	a
plant	WL	*Lathyrus hirsutus* L.	hrachor chlupatý	Fabaceae	terrestrial	a
plant	WL	*Ludwigia* × *kentiana* E.J. Clement	zakucelka	Onagraceae	terrestrial (aquatic)	pe aq
plant	WL	*Ludwigia grandiflora* (M. Micheli) Greuter & Burdet	zakucelka velkokvětá	Onagraceae	terrestrial (aquatic)	pe aq
plant	WL	*Oenothera depressa* Greene	pupalka vrbolistá	Onagraceae	terrestrial	b
plant	WL	*Oenothera fallax* Renner	pupalka klamná	Onagraceae	terrestrial	b
plant	WL	*Oenothera issleri* Renner ex Rostański	pupalka Isslerova	Onagraceae	terrestrial	b
plant	WL	*Panicum miliaceum* subsp. *ruderale* (Kitag.) Tzvelev	proso seté rumištní	Poaceae	terrestrial	a
plant	WL	*Paulownia tomentosa* (Thunb.) Steud	pavlovnie plstnatá	Paulowniaceae	terrestrial	t
plant	WL	*Rudbeckia hirta* L.	třapatka srstnatá	Asteraceae	terrestrial	pe
plant	WL	*Sisymbrium volgense* E. Fourn.	hulevník povolžský	Brassicaceae	terrestrial	pe
plant	WL	*Spiraea* sp. (excluding native species)	tavolník	Rosaceae	terrestrial	s
animal	WL	*Anoplophora glabripennis* (Motschulsky, 1853)	kozlíček	Cerambycidae	terrestrial	invertebrate
animal	WL	*Babka gymnotrachelus* Kessler, 1857	hlaváč holokrký	Gobiidae	aquatic	fish
animal	WL	*Bison bison* (Linnaeus, 1758)	bizon americký	Bovidae	terrestrial	mammal
animal	WL	*Capra aegagrus* Erxleben, 1777	koza bezoárová	Bovidae	terrestrial	mammal
animal	WL	*Corbicula fluminalis* (O. F. Müller, 1774)	korbikula brakická	Cyrenidae	aquatic	invertebrate
animal	WL	*Dreissena bugensis* Andrusov, 1897	slávička	Dreissenidae	aquatic	invertebrate
animal	WL	*Gammarus tigrinus* Sexton, 1939	blešivec	Gammaridae	aquatic	invertebrate
animal	WL	*Ictiobus cyprinellus* (Vallensciennes, 1844)	kaprovec velkoústý	Catostomidae	aquatic	fish

Taxon group	List category	Species (scientific name)	Czech name	Family	Environment	Life history/ taxon group
animal	WL	*Lasius neglectus* Van Loon, Boomsma & Andrásfalvy, 1990	mravenec	Formicidae	terrestrial	invertebrate
animal	WL	*Lepomis auritus* (Linnaeus, 1758)	slunečnice ušatá	Centrarchidae	aquatic	fish
animal	WL	*Lepomis cyanellus* (Rafinesque, 1819)	slunečnice zelená	Centrarchidae	aquatic	fish
animal	WL	*Misgurnus anguillicaudatus* Cantor, 1842	piskoř dálnovýchodní	Cobitidae	aquatic	fish
animal	WL	*Neogobius fluviatilis* (Pallas, 1814)	hlaváč říční	Gobiidae	aquatic	fish
animal	WL	*Orconectes immunis* (Hagen, 1870)	rak	Cambaridae	aquatic	invertebrate
animal	WL	*Orconectes juvenilis* (Hagen, 1870)	rak	Cambaridae	aquatic	invertebrate
animal	WL	*Orconectes virilis* (Hagen, 1870)	rak	Cambaridae	aquatic	invertebrate
animal	WL	*Perccottus glenii* Dybowski, 1877	hlavačkovec Glenův	Odontobutidae	aquatic	fish
animal	WL	*Ponticola kessleri* (Günther, 1861)	hlaváč Kesslerův	Gobiidae	aquatic	fish
animal	WL	*Procambarus acutus* Girard, 1852 / *zonangulus* Hobbs, Jr. & Hobbs III, 1990	rak	Cambaridae	aquatic	invertebrate
animal	WL	*Procambarus alleni* Faxon, 1884	rak floridský	Cambaridae	aquatic	invertebrate
animal	WL	*Procambarus clarkii* Girard, 1852	rak červený	Cambaridae	aquatic	invertebrate
animal	WL	*Procambarus fallax* (Hagen, 1870) f. *virginalis*	rak mramorovaný	Cambaridae	aquatic	invertebrate
animal	WL	*Psittacula krameri* Scopoli, 1769	alexandr malý	Psittacidae	terrestrial	bird
animal	WL	*Salvelinus alpinus* (Linnaeus, 1758)	siven severní	Salmonidae	aquatic	fish
animal	WL	*Sciurus carolinensis* Gmelin, 1788	veverka popelavá	Sciuridae	terrestrial	mammal
animal	WL	*Thymallus baicalensis* (Dybowski, 1874)	lipan bajkalský	Salmonidae	aquatic	fish
animal	WL	*Umbra pygmaea* DeKay, 1842	blatňák menší	Umbridae	aquatic	fish